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Man's Internal Gyroscope

Technology Transfer:
Values in Conflict

Advice from a Winner in the
Innovation Game

George Kistiakowsky
Speaks Out
Against Enhanced
Radiation Warheads

Technology Review

Edited at the Massachusetts Institute of Technology

T.R.W.

ALIAS
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**THE
NEUTRON
BOMBER**

technology review

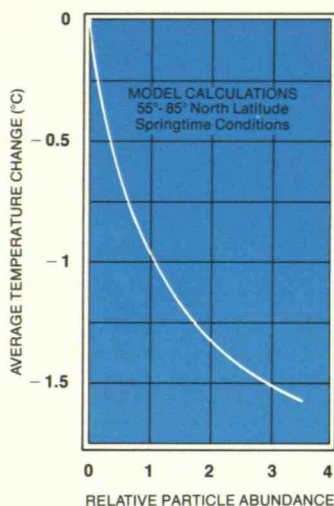
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Churning throughout the earth's atmosphere are substances that could change the climate of tomorrow. One way in which scientists the world over try to anticipate the possible effects of these substances is via mathematical modeling. That's the approach we've been taking here at the General Motors Research Laboratories.

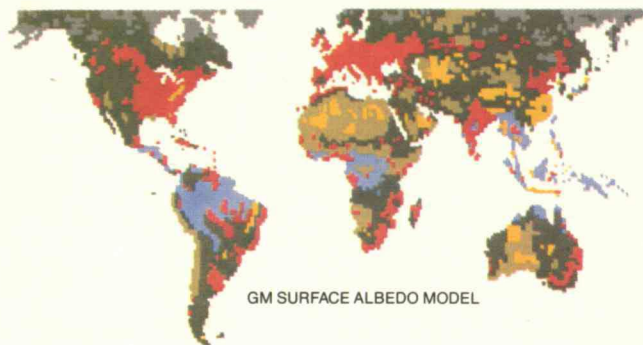
Our scientists started with one of the most complex atmospheric representations in existence: the radiative-convective model developed at Princeton University. They then reformulated it to include airborne particles.

Among the early uses of this new tool was an attempt to correlate an ice buildup in the Far North in



1971 with a reported jump in particle abundance. Just prior to the jump, four volcanoes had erupted in this region. Calculations with the model indicated that the particle increase could indeed have lowered temperature, thus delaying the spring melt and hastening the fall freeze (see graph).

In other experiments, we studied over 30 parameters . . . gas concentrations, albedos (reflectivities of the earth's surfaces), cloud and particle abundances, Rayleigh scattering coefficients. The goal has been to understand global temperature response to changes in O_3 , CO_2 , particles, and the chlorofluoromethanes.

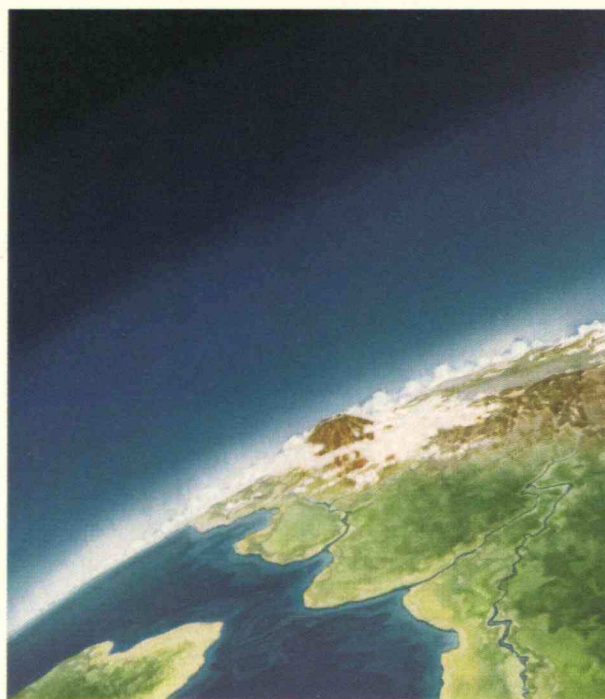


So far, our findings lead to these main conclusions:

- Surface albedo exerts the most influence on global temperature change. Next in importance are Rayleigh scattering, humidity of the lower troposphere, and CO_2 .
- Atmospheric particles work against the temperature increase attributed to CO_2 (the greenhouse effect).

Global temperature modeling: One of the many ways we're helping to explain, and maintain, this planet Earth.

Global temperature... looking toward 2001.



**General Motors
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Technology Review

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Enhanced Radiation Warheads, Alias the Neutron Bomb

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As an addition to the United States' nuclear arsenal, the neutron bomb would be ineffective and excessively costly, and its use in warfare would be inhumane.

The Dynamics of International Technology Flows

Denis Goulet

Transnational corporations often contract to teach technology to their host countries. But now these countries are learning the difference between technology's use and its mastery.

Man's Internal Navigation System

Laurence R. Young

Everyone gets disoriented, experiences motion sickness, or loses balance temporarily. Something about the human guidance system causes it to fail in such predictable ways.

Are You Ready to Become an Inventor?

Louis Soltanoff

If you've the germ of a marketable idea, you may already be an inventor. But the companies you approach would probably rather live in a fantasy world where the demand for their existing products never wanes.

How to Put Technology Into Corporate Planning

Alan R. Fufeld

Technology is an overlooked stepchild in most corporate planning. Here is a plan to put technology on a par with manufacturing, marketing, and sales in the competition for corporate resources.

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Changing the Schedule

For many years, *Technology Review* was published monthly from November through July. The idea was that nothing happened on the campus we serve in June, July, and August — with students at home and faculty away — so there were no issues with deadlines falling in those months.

The campus is different now, for teaching and research are year-round enterprises. And *Technology Review* is different, too — being far less dependent on its academic roots. Accordingly, we're changing our schedule slightly to provide eight issues of the *Review* each year at more regular intervals. Our next will be called June/July, ready about July 1. Then will come August/September, waiting when readers return from summer vacations; and then October, November, December/January, February, March/April, and May. □

A Regretful Announcement

This is the last appearance on our masthead — at least for now — of Deborah McGill, who has for two years been editor and manager of our columns and our "books and comment." The wisdom and cheer which she brought to *Technology Review* will now be devoted to *Harper's Magazine*, whose editors we envy. — J.M. □

Letters

Minerals and the Market System

William A. Vogeley's article, "The State of Our Mineral Position" (*October/November*, pp. 65-68), is indeed provocative! Although inertia in the response of supply and demand results in volatile mineral prices and blurs the long-term trends, the market system surely *does* work in the long run. How else can one explain the massive investments by private corporations in oil production to the detriment of traditional energy sources? In spite of short-term fluctuations, an overwhelming long-term demand was sensed and met by the industrial decision makers.

The mineral producers who survive certainly cannot afford to assume that they "can pass on increased costs without danger to profit margins!" What they may have decided is that at present it is cheaper and less risky to develop new sources rather than make significant advances in mining technology for existing sources. Only a waster of human and capital resources will over-engineer a product to meet a given level of demand.

William Vogeley is right in saying that disposable bottles are wasteful of mineral resources. But are they wasteful of total resources — mineral, human and capital? Market forces have determined that they

are the most cost-effective solution given the consumer's price and convenience requirements. Until the price of sand goes through the roof I suspect this state of affairs will prevail! On the other hand, we are careful to recycle certain materials such as copper simply because of their relative scarcity as reflected in prices.

The fact that mineral resources are finite will mean that sooner or later their cost will increase, not because of "imperfect market systems and institutional arrangements," but simply because demand will outstrip supply at the previous lower prices. In addition, deliberate institutional distortion of market systems for social, political, or strategic reasons will also tend to increase costs.

There is no doubt in my mind that from a purely economic point of view mineral resources are at present insignificant relative to labor and capital resources. Even the quadrupling of oil prices in the early 1970s has had a very small impact on total consumption for a given level of world economic activity! For instance, have the developed nations stopped using automobiles in favor of public transport or bicycles? The reason why the oil crisis has remained in the headlines for so long is that its strategic and political implications are very serious.

R. Evans
Bristol, England

Dr. Vogeley responds:

Evans chooses an unfortunate example to illustrate that the market system works in the long run. The petroleum industry in the United States and in most industrialized countries has been controlled directly and indirectly by society rather than markets for many years. In the United States, this has taken the form of prorationing systems, special tax provisions, price controls on natural gas and oil, and import quotas. In Europe, very high product taxes as well as other measures are prevalent. My point is not that markets do not work in the long run, but that they may work very badly.

My remark concerning the passing on of costs was in the context of less than optimum incentives for innovation. The point is that private decisions are skewed toward less beneficial outcomes from society's point of view.

Our mineral resource use is wasteful because pricing has not included the externalities which are real costs to society. If disposable bottles bore both the internal and external cost of disposition as part of their price, perhaps they would not be used.

A major point I was making was that society does not need to worry about exhaustion. If we do run into higher prices, aside from the internalization of external costs, it will flow from imperfect market systems and institutionalized arrangements, not from exhaustion. Finally, I am glad Evans agrees with my final provocation.

Energy Left to its Own Resources

I wonder if some of the older readers might have been startled by the story, "The Logic of Energy Conservation" in the January issue. Perhaps they have begun to fear that the later generation of radicals has thrown doubt on the first law of thermodynamics. For their peace of mind, it might be well to append to the article a reminder that energy is always conserved when left to its own resources. It is man's selfish urges to destroy entropy that leads to our frustration.

Marshall Burns
Toronto, Canada

No "Breather" For the Breeder

In the article, "Uranium Dependence and the Proliferation Problem" (*June*, pp. 18-24), Dr. Jacoby has developed an excellent overview of the supply and demand of nuclear fuel. His estimates of future trends in uranium supply, enrichment capacity, and enriched uranium stockpiles are reasonable and in our opinion highly probable. However, some of the conclusions implied by his numbers depend on factors not considered in his article.

Dr. Jacoby suggests that the possible stockpiles and surplus of nuclear fuel will allow the U.S. to "take a breather" in developing the breeder. Nowhere does he lay out the expected time to develop a breeder. In fact, estimates over the last decade have consistently underestimated the time to plan and construct key segments of the breeder program. The utility industry will not make commercial commitment to a new technology until the technology and economics have been sufficiently demonstrated. Thus, if commercial demonstration breeders were planned now for operation by the late 1980s, utilities might start ordering a few plants in the early 1990s for operation in the early 2000s. Yet Dr. Jacoby's figures clearly indicate that large numbers of nuclear plants will become operational in 2000 at the precise time when resource constraints should be growing. Thus, even if our breeder program continued full speed ahead, from a marketing point of view the effort is already perhaps a decade behind schedule.

The same criticism is valid for Dr. Jacoby's suggestion that there is time to take a breather in developing reprocessing. If this type of reasoning had been applied to light-water reactors (LWR) during the 1950s, with increasing reserves of fossil fuels the order of the day, would the U.S. have the nuclear capability that it does today? Wouldn't the U.S. also be better off if we had speeded up LWR development so that we would now have double the on-line LWR capacity and could reduce our electric utility dependence on oil and gas by another one million barrels per day oil equivalent?

Dr. H. H. Woodson
Dr. M. L. Baughman
John B. Gordon

Dr. Woodson is Director of the Center for Energy Studies at the University of Texas at Austin, Dr. Baughman is Director for Systems Analysis at the Center, and Mr. Gordon is a Research Engineer in the Systems Analysis Division. — Ed.

Sweetening the Facts

It is disturbing that Dr. Ian Nisbet ("The Bitter Problem of Sweets," October/November, p. 6) in his eagerness to express his personal beliefs has failed to obtain essential documentation for the rudimentary materials of his scientific argument concerning saccharin.

Dr. Nisbet stated that "the experiment, conducted in Canada, which triggered the furor was as straight-forward and decisive as such experiments ever can be."

This is an interesting interpretation since the Canadian rat test has been severely criticized in the scientific community and was not even designed to test saccharin but to investigate the carcinogenicity of a saccharin impurity, namely, OTS. In nearly every scientific forum in which the study has been discussed, serious questions have been raised about its methodology and its relevance to human experience.

For example, Dr. Frederick Coulston, a noted toxicologist from Albany University, stated in an article in *Chemical Engineering News*: "The Canadian studies of saccharin consisted of only one group of rats, which was fed a high dose of saccharin — so high that it interfered with the normal physiological state of the animals, resulting in a loss of electrolyte in the urine. It also resulted in loss of greater than ten per cent body weight, which is usually accepted by most toxicologists to indicate a chemical dose that is too high. Furthermore, there were no adequate controls for the saccharin fed animals. Extrapolation of these data to predict cancer in man is as far-fetched as saying the moon is made of green cheese even after the astronauts have landed."

The Canadian rat experiment failed to include about 90 items of information which the National Cancer Institute gives as a minimum in its guidelines concerning carcinogen testing in small rodents. Additionally, many who stress the need for high dose animal studies, are not familiar with the fact that the maximum tolerated dose was almost certainly exceeded in the Canadian saccharin experiment, and that saccharin is one of only a few substances which have been tested, at any level, in a two-generation model. Thus, the experiment is not "straightforward and decisive" as stressed by Ian Nisbet.

Additionally, since a 1974 request by the National Academy of Sciences, extensive epidemiology studies have been completed — all but one of which showed no association between saccharin usage and human bladder cancer. It was determined that saccharin is not metabolized
Letters continued on p. 15

MATERIALS RESEARCH CENTER REPORTS...

... On Making Brittle Bonding Metals Ductile.



The nickel-based alloys used for brazing stainless steel are normally extremely brittle. This brittleness makes it impractical to manufacture these alloys as thin foils, although foils are the most convenient form for brazing. As a result the nickel-based alloys have been available only as powders.

At the Materials Research Center, Dr. N. DeCristofaro has succeeded in producing nickel-based brazing alloys in the form of flexible foils by rapidly quenching them to the glassy state. In the foil form the alloys can be bent to conform to complex joint geometries, or punched to precise shapes. This avoids the difficulties associated with delivering powdered metals to joints that are to be brazed.

The new glassy brazing foils are currently being tested for use in the aerospace, automotive and chemical processing industries. Their unique properties and simple structures are helping to transform the art of brazing into a science.

Allied Chemical Corporation / Materials Research Center
P.O. Box 1021R, Morristown, New Jersey 07960.



To Cultivate Our Garden



Kenneth E. Boulding is President-elect of the American Association for the Advancement of Science, Distinguished Professor of Economics at the University of Colorado at Boulder, and a director of the Institute of Behavioral Science. He writes regularly for the Review.

I feel the need for a new word, as I can find none with which I can label myself politically or morally. I am neither a radical, a liberal, a conservative, a right-winger, a left-winger, a libertarian, nor a socialist. And if no name exists to describe me, I must be crazy: an occupant of a one-pigeon pigeonhole. As I naturally reject that hypothesis, I want to find a name for at least a two-pigeon pigeonhole. Then somebody may turn up and say, "Ah, yes, I am a whatsis too." The name "whatsis," however, lacks pizzazz; it sounds dangerously like a name for no pigeonhole at all. So I propose to take the bull by the horns — or at least the pigeon by the beak — and write a name above my pigeonhole in the hope that other pigeons will recognize it and pay me a visit.

Roots and Fruits

The name I have written above my pigeonhole is "fructal." Just as the word radical is derived from roots, fructal is derived from fruits. My text for this sermon is "By their fruits ye shall know them" (Matthew 7:20).

There may be a deep Freudian reason for my dislike of the word radical. In any case, I always liked apples and oranges better than parsnips and turnips, nutritious though they may be. To continue the biological analogy, the seed produces both the roots and the fruits, but only the fruits contain the seeds. And it is no accident that radicals have a curious tendency to resemble potatoes, roots that look like fruits but have no seeds.

I am not a radical, therefore, because I think the fruits of radicalism are often tasteless and sour. No rutabaga ever produced a juicy orange. The reason: radicals tend to know what they do not want, but not what they do want. They are avoiders rather than approachers, weeders rather than planters. I can sympathize, since it is

much easier to know what you disapprove than what you approve. I am against war, poverty, ill health, hatred, discrimination, racism, sexism, and ageism. These are clear objectives. I am in favor of every human-fertilized egg reaching as much of its potential as the limitations of the earth's ecosystem will permit, and this objective is very hard to spell out. The weeds we know; the fruits we only surmise.

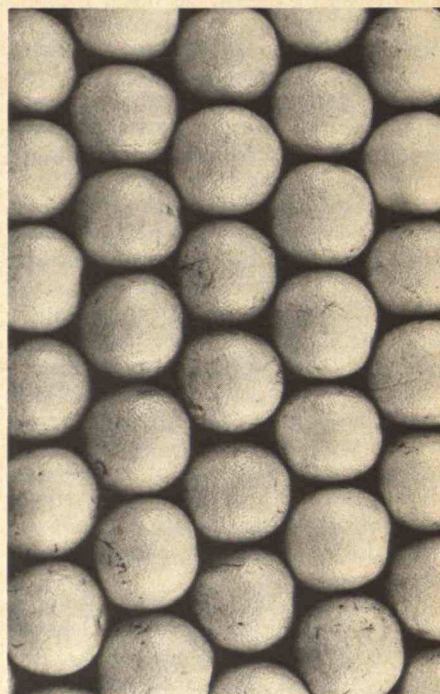
I do not believe that we nourish these fruits — or even eliminate the weeds — by revolution or by most modes of radical change. Our garden flourishes by means of much more complex, productive, and directed evolutionary processes. The fruits of radicalism can easily be tyranny, dullness, uniformity, conformity, suppression of creativity, manipulation, and diminished human potential. In this respect the radical right is even more pernicious than the radical left. It too breeds tyranny, violence, oppression, and repression, and in the name of market freedom it can easily crush the freedom of the individual, freedom of expression, and freedom of debate, as we see in Chile, Argentina, and Uruguay.

From Bad to Worse

Because I am not a radical, I am not necessarily a conservative — at least in the sense of the conservative who thinks all change is for the worse, that all existing vested interests should remain vested forever, and that however bad the world is it is still the best of all possible worlds.

There is a famous story of an Oxford don who said that whenever a change was proposed he asked himself, "Is this a good change?" The answer was usually "no." But if the answer was "yes," he asked himself a further question: "Is this change timely?" To this question the answer was invariably "no." I do think a great many changes are for the worse. Indeed, insofar as the generalized second law dominates nature, the law of nature is the law of moths and rust, of erosion, aging, and decay. Everything happens because a potential exists for it to happen. And on a wet Monday morning in November it is not difficult to see the universe as a process of the inexorable using up of some mysterious initial potential, in which everything goes from bad to worse.

Fortunately, evolutionary systems — both biological and social — offset this tendency so that change for the better is possible. The hidebound conservative who resists the second law through rear guard actions can only hope to slow down the pace of undesirable change. But another variety of conservative can be



Fredrik D. Bodin, Stock, Boston

flexible enough to direct change in desirable directions, without laboring under the radical illusion that change is good for its own sake. People who are suspicious of change are most likely to set us on the path to improvement.

It is no accident that so much fruitful social change has been achieved by people who are labelled conservatives: Bismarck, Disraeli, even Nixon. In contrast, revolutions are likely to come full circle and to reestablish something like the old regime in a new costume. Stalin was distressingly like Ivan the Terrible, and Mao like the Emperor Wang Mang, who socialized China nearly 2,000 years ago. Kim Il Young in North Korea appears to be setting up a hereditary communist monarchy, and the excesses of British imperialism are mild compared to those of Idi Amin in Uganda. The mantle of imperialism seems to have fallen even upon Castro, who is horsing around the world with all the enthusiasm of L.B.J.

When it comes to human betterment, there is a lot to be said for the injunction of the old labor song: "Take it easy, but take it." I would say, "Grow it easy, but grow it." Much tragedy arises from the illusion that good things can only come by relentless struggle. In fact, most good things come by plowing, planting, growing, making, and working — the endeavors that produce fruits. Let us all, radicals and conservatives, join together in the ranks of the fructalists. □

The national guilt complex • Achievement or original sin • Production vs. atonement

Judging by some of what we read and hear, self-flagellation seems about to become the order of the day. Much of whatever Americans do or achieve or enjoy is termed immoral or otherwise indefensible, and what people in other countries do is hailed as the shape of the future, morally speaking.

Well, now.

A lot of this national guilt complex depends on how things are put.

Suppose, for example, we ask you, "Do you think it's right for the United States, with only 5% of the world's population, to consume 28% of its energy?" That might be your cue to beat your breast and cry, "Heavens to Betsy, no! How could we do such a thing? And how can we atone?"

Suppose, however, we rephrase that question and ask you, "Isn't it remarkable that the United States, with only a twentieth of the world's population, can produce a fourth of the entire world's goods and services? And that we have become the industrial and agricultural breadbasket of the world... a prime purveyor to the hungry and the needy abroad?"

"Gee," you might say. "Just shows you what the old Yankee ingenuity, along with hard work and clean living, can do."

We can stomach breast-beating or a hair-shirt demonstration, if that's what gives the other fellow his kicks. But the point we want to make is that nobody in this country has to beat himself over the head just because he's adequately fed and clothed. Mankind has always striven for a land flowing with milk and honey, not a land short of necessities and barren of luxuries, long on deprivation and longer on austerity.

This is not a plea for devil-may-care hedonism. On the contrary, we are trying to make two points:

(1) Gratuitous martyrdom is an exercise in futility.

(2) When someone tries to make you feel guilty because our country has achieved to a considerable degree what all countries strive for, don't leap to the bait. Remember, it's possible to state even the most positive accomplishments in a way that makes them sound like original sin.

We get the distinct impression that most of the people who berate this country for its productivity are themselves quite well fed, well clothed, well housed, and, possibly as a result, feeling guilty. We cannot believe that Americans can solve, or even alleviate, the problems of this country and the rest of the world through starvation diets or by sleeping on a bed of nails. A refrigerator or a loaf of bread or a pair of shoes not bought and used in the United States is not automatically going to end up in some less-developed country.

The point is that our country is so productive, despite all the roadblocks thrown up by government and others, that it can turn out an almost unbelievable volume of goods—enough to supply the domestic market and still have a lot left over to export. If you want more U.S. money and food and other goods sent to needy peoples abroad, fine; tell your Senators and your Congressman so. But don't feel guilty about living well if you already do, or about wanting to if you don't.

We are not trying to promote gluttony or even conspicuous consumption. We are trying to deflate what strikes us as nonsense. Life is short, and people who work hard and productively shouldn't reproach themselves over their rewards, especially since producing for plenty makes society a lot more comfortable than sharing unnecessary shortage. To some people pleasure may be a little sinful, but if there were no sin in the world, what would be the benchmark for virtue?

Mark Twain once commented that on the basis of the information reaching him, his choice would be heaven for climate and hell for good conversation. Maybe he had something there.

Weather: No Picnic for Forecasters



Robert C. Cowen, Science Editor of the Christian Science Monitor, won the 1977 A.A.A.S.-Westinghouse Science Writing Award. He is former President of the National Association of Science Writers, and is a regular contributor to the Review.

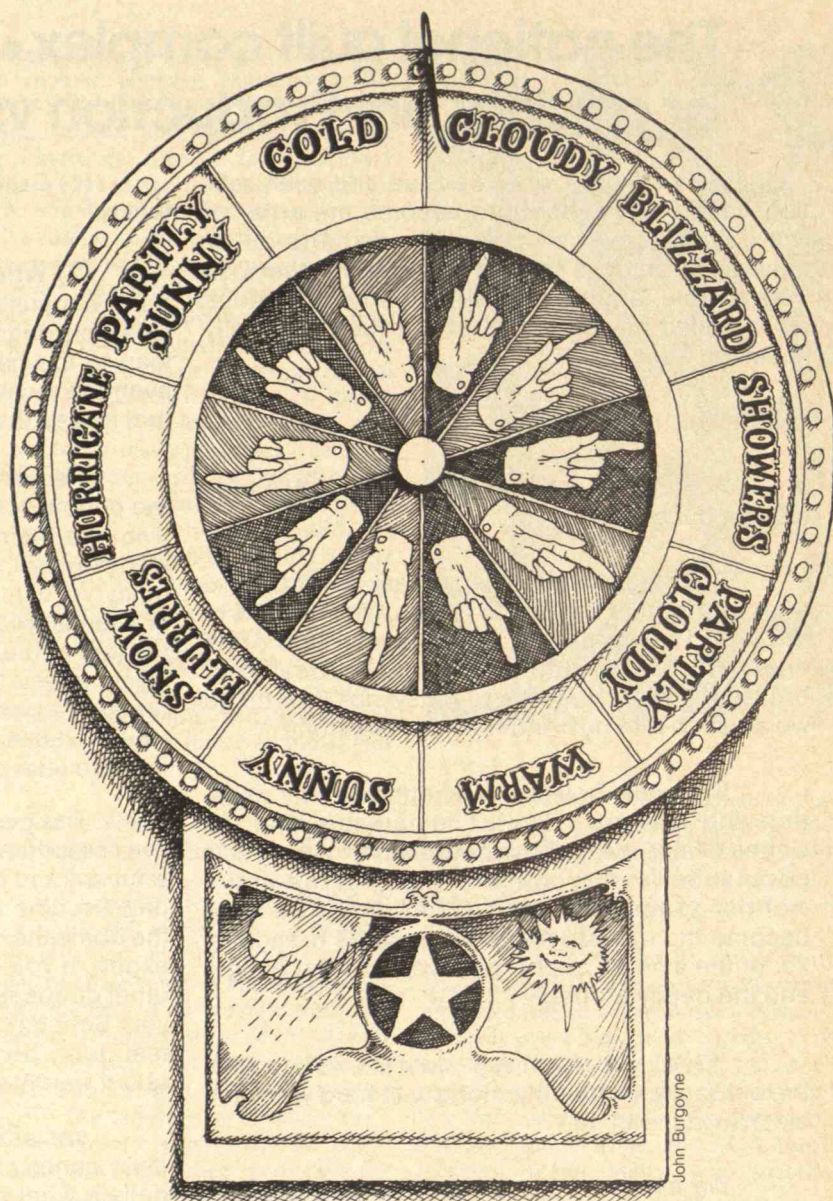
Meteorologist Helmut Landsberg has a quixotic mission: to delete the word "normal" from the lexicon of climatology. He admits the term is so widely used that it probably won't be dropped, but still he tilts at it.

"Normal" implies a healthy state (such as normal body temperature), any departure from which is pathological, Dr. Landsberg explains. And he sees nothing pathological in the droughts, floods, and fierce winters that have challenged our concept of "normal" climate in this decade.

Weather, the University of Maryland climatologist believes, has its own conception of "normal": it varies from year to year. Anyone seeking to find a significant trend in climate change — a trend that would predict climate for the rest of this century — will "be as disappointed as those who play the stock market."

This pessimistic judgement is one of the few points on which climatologists agree. It emphasizes the frustrating uncertainty that faces government policymakers who now realize that weather is a factor in their long-term plans.

In the U.S., more money and effort are being channeled toward climate research. President Carter asked for \$104 million for such research in his 1979 budget, 37 per cent more than in fiscal 1978. Further, at this writing he was expected to create a National Climate Program Office within the National Oceanic and Atmospheric Administration (N.O.A.A.), and to ask Secretary of Commerce Juanita Kreps to head an interagency climatic board to set goals and coordinate climate-related activities at the federal level. By now, these actions may already have been accomplished. And a sure sign of the field's increasing importance in Washington is the newsletter *Weather & Climate Report*, inaugurated to keep subscribers in touch with new research results.



John Burgoyne

Internationally, a meeting is scheduled for next February in Geneva where meteorologists will discuss the social and economic implications of severe weather. J. Murray Mitchell, Jr., Senior Climatologist of N.O.A.A.'s Environmental Data Service, explains that considerable mystery continues to surround the impact a hard winter or drought has on a region. Catastrophes have obvious, immediate effects. But the full impact is often a subtle, prolonged affair. Dr. Mitchell says there is urgent need to clarify both short- and long-term effects so that weather-related planning can be performed more knowledgeably. But Dr. Landsberg argues that "there is very little reason to think that climate has gotten out of hand. The real problem is that population increases have

placed greater demands on food supplies and the disarray of fuel supplies has made a cold winter a threat to large population groups."

A Collective Guess

Faced with these attendant threats and with the experts' inability to foretell what kind of severe weather will happen when, what is a planner to do? One alternative is to poll the experts as to what they think likely to happen, even though they would all refuse to dignify their guesses with the distinction of "forecast." Nevertheless, the National Defense University (N.D.U.), on behalf of itself, N.O.A.A., the U.S. Department of Agriculture, the Defense Advanced Research Projects Agency, and the Institute for the Future has been polling

meteorologists. The N.D.U. aims both to pin down what climatic changes, if any, seem likely over the next 25 years and what they imply for agricultural planning. At the American Association for the Advancement of Science February meeting, William R. Gasser reported that this exercise in "aggregated subjective probability forecasting" comes down to a collective guess that the weather most likely will continue to resemble that of the past 30 years. If anything, climatologists tended to anticipate a slight warming, rather than a cooling, with any change in average temperature amplified at the poles. The meteorologists gave only one chance in ten for a temperature fluctuation greater than 0.6 °C increase or 0.3 °C decrease in the 25-year period. The one exception to this expectation of weather as usual was some anticipation of drought in the North American high plains in the mid 1990s.

A drought cycle of roughly 20 years in that region appears somehow linked to the sunspot cycle. Nobody knows if, or how the relationship operates. Dr. Mitchell noted that statistical evidence drawn from tree-ring data, analyzed at the University of Arizona, supports the correlation, which can be traced back to 1700. The highest risk of drought in the western U.S. occurs a few years after alternate sunspot minima (the 22-year double sunspot cycle). But Dr. Mitchell dismisses would-be drought forecasters who would grant "any practical predictive significance" to the correlation. "A whopping drought can occur at the wrong part of the sunspot cycle," he says. But for what it's worth, he reports that the U.S. is now coming out of the highest-risk period and the next such period is "due" in the mid-1990s.

Thus Dr. Gasser's exercise in "subjective probability" forecasting tells planners to expect weather as usual, acknowledging Dr. Mitchell's caution to anticipate more extremes such as those that have in the last decade given parts of the U.S. their worst weather in a century. Seen in the perspective of recent centuries, weather has been relatively calm for 15 to 20 years. Dr. Mitchell says that respite is now over. It's just like playing dice, Dr. Mitchell said. After a run of sevens (milder weather), the probabilities favor other faces (more extreme weather), and another string of sevens is unlikely.

The CO₂ Catastrophe

Looking beyond the end of the 20th century, however, climatologists do see a new, potentially serious threat beginning

to take shape. In about 25 years, the carbon dioxide (CO₂) signals will emerge from the meteorological noise in computer simulations of future weather. The mathematical models of climate, while admittedly crude, all point to CO₂ as a growing problem. This gas is produced by burning fossil fuels. It accumulates in the air where it captures outgoing heat and reflects some of it to the earth. Model studies and rough theories of climatic change both suggest that the unrestrained burning of carbon-rich coal will nudge this warming too far sometime in the next century. It might melt the icecaps, cause floods in many major coastal cities, or change precipitation patterns. Whatever problems it actually would cause, the first clear signs of danger probably won't be seen until around the year 2000. By then, it could be too late to stop the trend: it could take 25 to 50 years to halt the burning of coal.

Thus energy planners face the biggest climatic uncertainty of all. Should they plan now to limit the use of coal? Or should they wait until research, including improved computer studies, gives a clearer view?

Some climatologists, such as Stephen Schneider of the National Center for Atmospheric Research, think waiting would be futile. Dr. Schneider believes it could take 25 years to achieve that kind of clarity and, by then, the atmosphere would have performed the experiment for us.

Does society want to take the gamble that the CO₂ problem won't be severe and wait to see what happens? Or does it want to decide now to limit future use of coal? Dr. Schneider unhesitatingly favors the latter, even if it means forcing energy conservation and development of other energy sources at a pace that could cause some economic hardship. So far, he hasn't persuaded many other experts that such drastic action is needed. But all agree that CO₂ research deserves a higher priority than it has received so far. □

personal and public

Ten Thousand Working Days

by Robert Schrank

"Throughout the book Schrank retains a humane, common sense view of life that now allows him to deflate some of the more ponderous theories that his fellow sociologists have concocted about his fellow workers . . . you could wade through a dozen government, academic, or corporate treatises on the quality of worklife without reading such common sense, expressed in vigorous English, and always buttressed by actual—and often riotously funny—personal experience."—*The Washington Monthly*

\$12.50

The Public's Business: The Politics and Practices of Government Corporations

by Annmarie Hauck Walsh
A Twentieth Century Fund Study

The public authority is a peculiarly American institution, a hybrid entity that depends on the private money markets for capital but is subsidized by the public in both direct and indirect ways. *The Public's Business* traces the growth of these governmental corporations. The book is a comparative study based on a large number—and variety—of authorities, including (among others) several Pennsylvania municipal corporations, the Port Authority of New York and New Jersey, authorities supervised by the Metropolitan Council of Minneapolis-St. Paul, and the U.S. Postal Service.

The book recommends that authorities should be made more accountable to the public, and it puts forth a number of proposals that would make their governing structures more democratic, open their operations to wider public scrutiny, and align their goals more closely with those of public policy.

\$19.95

A New Guide to Federal Cable Television Regulation

by Steven R. Rivkin

\$25.00

The MIT Press

Massachusetts Institute of Technology
Cambridge, Massachusetts 02142

Animal Liberation



David F. Salisbury, who reports on science for the Christian Science Monitor from its West Coast Bureau, is a regular contributor to the Review. He studied physics at the University of Washington (B.S. 1969).

The antivivisection movement is cutting the silken threads of sentimentality which have bound it for decades and undergoing a wondrous metamorphosis. A new set of philosophical wings, though scarcely tried, promises to give it a new moral force.

In Hawaii, two technicians took it upon themselves to free dolphins being used for research because they felt it was not right to keep such intelligent creatures captive.

In England, activists calling themselves the Animal Liberation Front have been conducting raids on animal laboratories and the breeders who supply them: freeing animals, damaging equipment, and destroying research documents.

In India, Prime Minister Morarji Desai, who opposes killing animals for religious reasons, was persuaded by an antivivisection group to ban the export of rhesus monkeys to the U.S. because they were

being used in weapons-related research.

This escalation in "extremist" activities is, ironically, powered by a utilitarian, rather than emotional, rationale. In the 1860s John Stuart Mill argued that the goal of society is the production of the greatest happiness for its members. Peter Singer took this philosophy a step further. In his 1975 book, *Animal Liberation*, the Oxford trained philosopher extended the social contract to all sentient life.

Animal Liberation embraces Darwinian logic, which implies that the difference between homo sapiens and the rest of the animal kingdom is a matter of degree, not kind. Mr. Singer maintains that because animals feel pleasure and pain they should be afforded a consideration equivalent to that given to humans.

This eminently rational if somewhat radical morality has provided antivivisection with an intellectual luster which it previously lacked. It has begun to attract those disaffected with the manipulative element in modern science and technology, and those who feel that a new ethic of reverence for all life is necessary.

While the antivivisectionist movement marshals new force, however, the rigid and almost hysterical polarization which has characterized their relationship to animal researchers is gradually dissolving into dialogue.

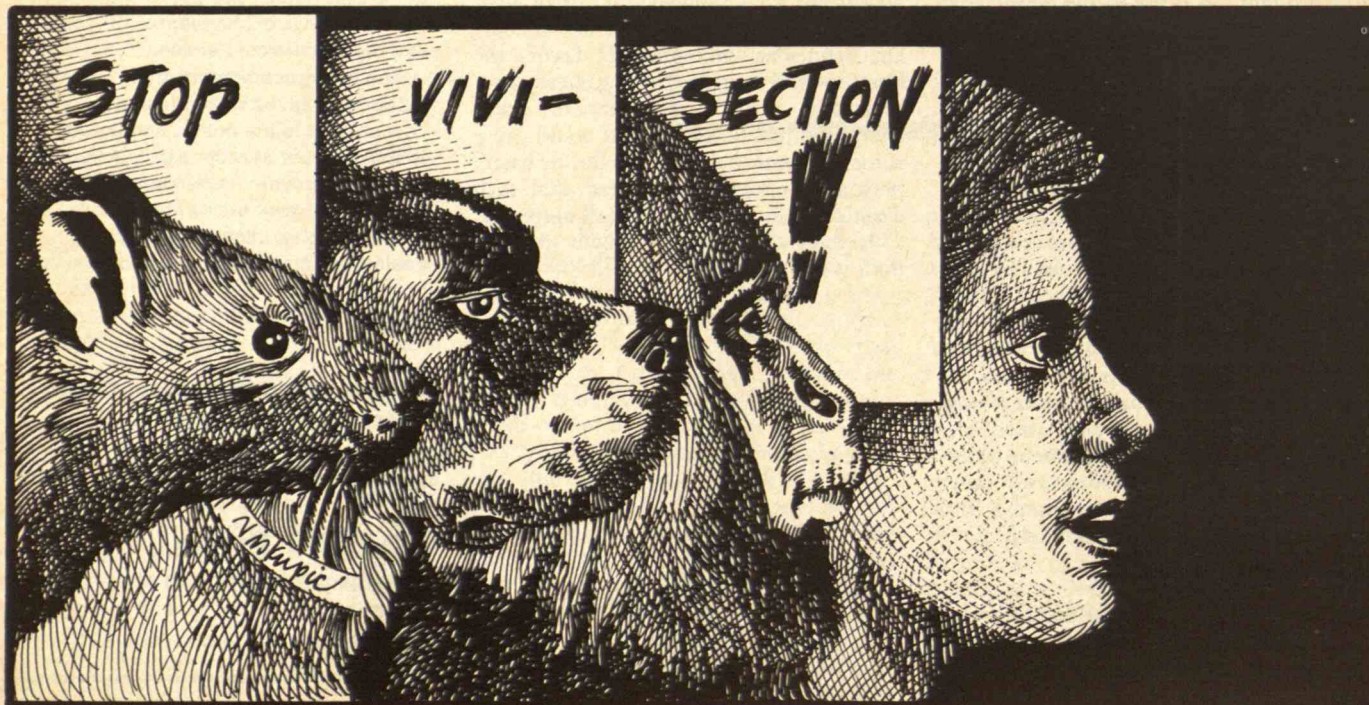
An increasing number of antivivisectionists are maintaining the more moderate position of Mr. Singer. Instead of de-

manding a complete and immediate cessation of all animal experimentation, they are pressing for a gradual reduction in the use of animals in research.

An illustration of the criteria which the moderate animal welfare groups would impose on animal researchers comes from Michael Fox, a veterinarian working with the U.S. Humane Society. He argues that an animal experiment should not be performed:

- ☐ When it is a needless repetition of research already well documented.
- ☐ When the degree of physical or psychological suffering of the animal over-rides any value either as a learning experience or as a source of scientific knowledge.
- ☐ When a more humane alternative is available, or when an organism of lower sentience can be used as a replacement.
- ☐ When the researcher cannot justify the use of animals for the betterment of society or of the animals themselves.
- ☐ When the experiment is poorly designed with inadequate hypotheses, controls, and statistical validation.
- ☐ When the experiment is conducted purely for profit motives, as in the development and testing of new, non-essential commercial products.

Dr. Fox speaks for the transcendent vision which has gripped the antivivisectionists when he declares: "It is for something more than mere human survival that we should be humane stewards and conserve wolves, forests, lakes, eagles,



Gary Viskupic

whales, and oceans. It is essential for human health and for the well-being of future generations. Humane stewardship in maintaining health and harmony within the biosphere and between all living things is as important as medicine in ensuring the physical and mental health of our species."

Utopian dreaming? That, at least, is the conclusion of Thurman Grafton of the National Society for Medical Research (N.S.M.R.), which has been the arch-rival of the antivivisectionists for many years.

"Specieism is a hollow argument," Dr. Grafton feels. "It is just not intelligent to maintain that animals are man's equals. Our concern for human welfare must be greater than for that of animals."

Mr. Singer's integration of utilitarianism and evolutionary theory have put animal researchers in a peculiar philosophical position. Whereas traditional antivivisectionists' main argument was Christian kind-heartedness; now biomedical scientists are finding justification in the Judeo-Christian tradition. "God gave man dominion over the animals," says Dr. Grafton. "They are here to serve man."

If N.S.M.R. sounds defensive, it is because tradition of animal researchers have a great deal to lose. Over 60 per cent of all biological research involves animals. Each year over 60 million animals are bought by research laboratories. Thus, animal research has become the keystone of a multi-billion dollar enterprise.

Despite the adamant resistance of groups like N.S.M.R., however, the siren song of anti-specieism appears to be making serious inroads into the community of animal researchers itself.

"I don't agree that animals are here just to serve man," objects W. Jean Dodd, a researcher with the New York State Health Department and Vice Chairman of the Institute of Laboratory Animal Resources of the National Academy of Sciences. "More and more scientists, particularly the younger ones, are becoming concerned with animal welfare," says Dr. Dodd.

According to Harry Rowsell, Professor of Pathology at the University of Ottawa and Director of the Canadian Council of Animal Care, "There is a reactionary group of scientists, exemplified by the N.S.M.R., who fear being interfered with. Their argument is similar to that of the gun lobby, that their independence must not be infringed."

Scientists have been fighting a rear-

Continued on page 64

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Proposals...a guide to Winning

A step-by-step guide to proposal preparation entitled **How to Create a Winning Proposal** is now helping engineering professionals score more wins in their proposal efforts. In a recent survey, users of the book reported an impressive 42% average increase in the success-ratio of their proposal projects during the past year. Of the users polled, 68% attributed their successful track-record to the guidelines provided in the book.

More like a roadmap than a book, "Winning Proposal" details the entire proposal sequence—giving concise, easy-to-use techniques for planning, organizing, writing and submitting a winner. It provides excellent guidelines on preparing both solicited and unsolicited proposals, and is ideally suited for use in engineering project proposal efforts. Outlines, checklists and sample forms are included to help get the proposal on target for a win.

Government requirements are covered in an overview of the U.S. procurement network, how it works, and how the proposing firm can increase its "win probability" in competing for contracts. Detailed instructions on how to analyze and respond to RFP's, RFQ's and IFB's are included. The book also contains an extensive list of government and commercial information sources to assist in pre-proposal research efforts.

Copies are available pre-paid from Mercury Communications Corp. 730-Q Mission, Santa Cruz, CA 95060. \$65 includes 3-5 day delivery inside USA. In Calif. add \$3.90 tax. For outside USA, \$76 (int'l money order includes air delivery. To order C.O.D. call 408/425-8444.

Vox Machina: The Music of the Machine



Paul Raeburn studied music at the Berklee College of Music and physics at M.I.T. (S.B.'72). At present, he is a freelance writer.

Computer music: machines artlessly generating sounds, coolly revising and organizing them, and delivering them on a reel of tape with no need for composers, musicians, or concert halls? Not at all. Concerts given at M.I.T. during the First International Conference on Computer Music revealed a wide range of artistic sensibility among composers using computers.

While some pieces required the addition of a live performer, most required only the four large speakers placed at the sides of the stage and the back corners of the auditorium. Some of the pieces were soft, expansive washes of sound. Others presented dizzying successions of very dense and percussive structures leading to climaxes of great intensity. Clearly, the computer in the hands of a talented composer is capable of producing music of great depth and feeling.

Computer music is music synthesized by a composer with the aid of a digital computer. The computer is able to generate mathematical representations of sounds according to the instructions of the composer. These representations may then be modified, filtered, and shaped to produce the sounds that the composer desires. The composer may establish a repertoire of such representations and then overlap and arrange them — just as a composer orchestrates conventional instruments — to form the actual composition, a succession of notes of various pitches and durations.

The composer who synthesizes music in this way has retained all the compositional decisions, leaving none to chance or the computer. He has far more control over his material than is possible in any other music. His control over dynamics and rhythm extends to the limits of human hearing. And he has an infinite range of timbres, being no longer limited



This keyboard in the M.I.T. Experimental Music Studio provides a natural way for composers to put musical information into the computer.

to the timbres of standard musical instruments. The role of the computer is essentially that of "performer" responding to the composer's instructions.

The potential for computer music was first demonstrated in the late 1950s by researchers at Bell Telephone Laboratories in Murray Hill, N.J. It came as a by-product of experiments with speech synthesis that led to the development of the digital-to-analog converter, an electronic device which transforms the numerical output of a computer into an audio signal. A digital representation of a sound consists of many measurements of the sound taken at a rate as high as 40,000 times per second. The digital-to-analog converter was needed to change these numbers into a smoothly varying voltage that could be applied to loudspeakers to reproduce the sound.

This device was soon applied to musical problems, and an early result was a music generating program known as MUSIC4 written by Max V. Matthews. This work attracted the attention of the Princeton Music Department, where Barry Vercoe developed the MUSIC360 program in 1969 for the I.B.M.-360 series of computers. It remains the most widely used program for music composition, now in use at some 35 locations around the country. Of 13 works played at concerts during the M.I.T. conference, nine were composed using MUSIC360 or its sister language, MUSIC11 (written for the PDP11/50 computer).

MUSIC360 is successful because it is designed to be musically intuitive; that is, it

allows the composer to think about composition in a way that is familiar to him. But weaknesses remain. The composer must still speak to the computer in the computer's language. His conventional score, with notes indicating pitch and duration, must be converted to the symbols used by the computer.

Composition involves not only the generation of musical ideas but also the analysis and evaluation of those ideas. The composer should have the ability to construct a musical idea, and then the opportunity to modify it, hear it played back to him, modify and hear it again, and finally to store some or all of it for later use.

A serious problem for a composer using MUSIC360 at a central university computer installation is that he may be forced to wait several days to hear any results of what he has written. Hence the direction of research at the M.I.T. Experimental Music Studio in which Professor Vercoe is now working. The task he has set for himself and his associates is the development of a computer music system that is highly responsive to the composer, one that allows him to communicate with the computer using standard musical notation.

The Studio's solution has been to communicate with its PDP-11/50 computer by means of a display computer equipped with a cathode ray tube and an organ keyboard. The result is a score editor that can be used by composers of conventional music as well as by composers of computer music, and an orchestra editor, de-

signed to assist the composer of computer music in setting up his "instruments."

The score editor displays the score which the composer has given it on the screen of the cathode ray tube. The composer may then change the notes on the screen to modify or correct his composition, changing pitches, durations, and even adding or deleting measures and phrases. He can then store these corrections to be instantly recalled when he needs them. He tests his composition by having the computer synthesize and perform for him as many as ten voices simultaneously. A plotter will also print copies of the score and parts for players.

The construction of "instruments" in computer-synthesized music requires the linking of many sub-programs corresponding to oscillators, filters, and shapers. It is natural for composers to visualize these instruments as a series of boxes connected by patch cords. The orchestra editor program provides such a representation on the screen of the

cathode ray tube. The composer is able to make boxes appear and disappear, and to connect them in any way he chooses. When he arrives at an arrangement he wants to test, he may have the computer synthesize the instrument's sound.

According to Dr. Vercoe, the electronic music studio designed around a minicomputer such as the PDP-11/50 will eventually replace languages such as MUSIC360 designed for central computer installations. The interactive capability of the minicomputer with cathode ray tube display will allow composers to devote more attention to their music, less distracted by the demands of computer technology.

Having mastered the arcane mechanics of computer music, composers may still have a problem — a very human one. At the M.I.T. conference, two tapes were stolen and others had to be substituted at the last minute. That's one hazard Seiji Ozawa need never fear, at least until the Boston Symphony Orchestra is kidnapped en masse. □



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A Recipe for Punch-Card Composition

Let's say you want to create a piece of music using MUSIC360. To begin, you must create your instruments. This is accomplished mainly by specifying *timbre* and *envelope shape*.

Any pitch produced by a conventional instrument contains numerous harmonics, or overtones, in addition to the fundamental pitch. These overtones color the sound, and give it a distinctive timbre. A pure pitch without harmonics sounds thin and lifeless. When using the MUSIC360 language, you, as composer, may specify the intensity of each overtone independently. You may also create complex varying overtones using subroutines provided by MUSIC360.

Once you've specified the timbre of your instrument, you must specify its envelope shape. The envelope describes the rise time and decay time of the note. A piano key when struck and held, for example, produces a sound which rises almost immediately to a peak value, and then gradually dies away. Its rise time is short, its decay time much longer. Tapping a drumstick

on a snare drum produces a sound with rise and decay times that are both very short. You may specify rise and decay times for your instruments shorter than the human ear can perceive, or as long as the entire composition, if you wish. Or you may assign a certain envelope shape to an instrument at the beginning and a different one later on.

In addition to specifying the timbre and speed of rise and decay for your instruments, you may add echo, or vibrato, or many other more complex variations.

When you have created a set of instruments, your "orchestra," you begin to write the score, which specifies the time at which each instrument starts and stops playing, as well as its intensity and pitch.

All of the information for the orchestra and the score must be encoded on punched cards. These are submitted to a central computer facility. There the program is computed, and its output is stored on tape in digital form. When this tape is processed through a digital-to-analog converter, the composition is complete. — P.R.

Scanning Electron Microscope: A New Art Medium?

Magnifications: Photography with the Scanning Electron Microscope

David Scharf

New York: Schocken Books, 1977,
119 pp.; \$24.95

Reviewed by Aviva Brecher

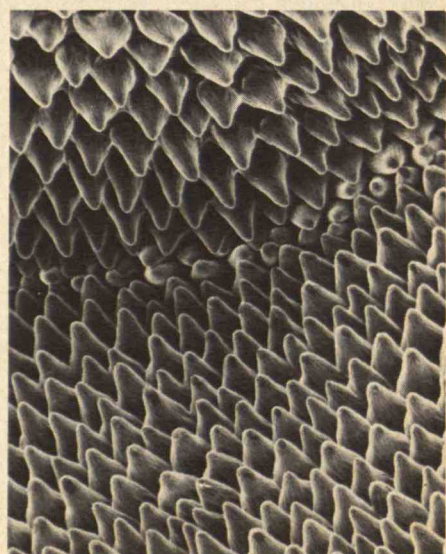
The scanning electron microscope (SEM) has become in the last decade a commonplace tool for scientific inquiry and technological study, extending, complementing, and even replacing optical microscopy in a variety of fields — from metallurgy to rock mechanics and from biology to textile polymers. The SEM affords unusual clarity of detail in viewing surface features, thanks to the great depth of field of its electron optics; its resolving power can be fine-tuned by changing the energy, and thus the penetrating power, of the electron beam up to a million volts. Magnification up to ten-thousandfold enables us to view in sharp focus the world on the Angstrom scale.

David Scharf, a master of his instrument, has grafted art onto technology in a novel way with this glossy collection of over 100 microphotographs of animals, plants, and inanimate objects. The SEM becomes a means of artistic expression as well as exploration, enriching and expanding the photographer's vocabulary. In stark black and white, Mr. Scharf populates the layman's mental-scape with startling new imagery of animal and plant life and reveals the hard-edged symmetries of crystals and complex textures of fibrous fabrics.

A novel contribution to SEM techniques is Mr. Scharf's use of live specimens immersed — without prior drying and standard gold-coating — in the high-vacuum chamber of the microscope. To minimize damage to his live subjects, Mr. Scharf subjects them to the gentlest electron beam possible (about 5,000 electron-volts of energy). Low magnifications solve the special technical problems posed by loss of contrast and by the image blurs that result when tiny hearts beat. Aesthetically, this solution is not a disadvantage because, on the very small scale, the pleasing symmetries of nature often break down.

The photographer's artistic statement clearly tempers his explorer's curiosity. And it guides his search among the signposts of exploration for images to

The surrealistic images revealed by the scanning electron microscope (SEM): a marijuana leaf (*upper photo*) sports hairs containing glandular resin nodules; specks of pollen (*lower left*) nestle in the unopened disc of an African daisy; eerie mounds (*lower right*) rise from the crease of a candytuft flower petal. (Photos: David Scharf)



capture on film. In this we recognize the traditional artistic selectivity exercised in an unorthodox medium.

To the entomologist, Mr. Scharf's insect-scapes may be familiar, factual portraits. But the uninitiated, delving like Alice into an unexpected Wonderland, may actually experience visceral horror at the sight of the monstrous hairiness of a jumping spider or feathery midge. The inverted perspective of a gladioli petal seen as a surrealist sea of breasts or the growth steps on salt crystals compose a vivid essay on natural symmetry and the relativity of size.

Many scientists who use the SEM in their research often allow aesthetic principles to influence their search for meaning. And meaning — in science — is usually found in regularities, patterns, symmetries — the repetitive and reproducible motifs which appeal to the mind's eye.

Indeed, most of us who probe with an SEM to photographically encapsulate microstructural information will have trouble switching mental gears to view Mr. Scharf's work as art. It is difficult to evaluate this photographic essay by established standards — of either art or technology — simply because it purports to chart new territory in no man's land.

Perhaps the greatest value of this collection of microphotographs is its ability to arouse our sense of wonder and quench our thirst for symmetries. This is an area where art and science often interface and intersect. Mathematicians such as Hermann Weyl have analyzed with the tools of Group Theory the symmetry patterns in nature, amplified and reproduced in human culture: in architecture, art, and music. Artists such as M. C. Escher have intuited and almost exhausted all the possible color group symmetries which had mathematical and physical reality, but not always artistic power. Physicists like Eugene Wigner in his essays on "Symmetries and Reflections" have delved into the hidden power of symmetry principles, which engender conserved or invariant quantities in the physical world. The SEM may also blur the often artificial boundaries between science, technology, and art, by revealing the beauty of form and structure in the microscopic world and beyond.

Aviva Brecher teaches physics at Wellesley College and is a Visiting Scientist in the Laboratory for Paleomagnetism of M.I.T.'s Department of Earth and Planetary Sciences. She occasionally uses the scanning electron microscope in her research to reveal the magnetic structure of ancient meteorites and moon rocks. □

Meanings of Energy

Energy: Historical Development of the Concept

R. Bruce Lindsay, ed.
Stroudsburg, Penn.: Dowden,
Hutchinson, & Ross, Inc., 1975, xiii +
369 pp.; no price

Reviewed by Elias P. Gyftopoulos

This volume is the first of a series of benchmark papers on energy. The book is intended "to trace the development of the concept from early times to the middle of the nineteenth century, when the concept had arrived essentially to its modern meaning . . ."

The editor begins by summarizing the significance of the field being covered. Important papers are translated or reproduced from some original source, and groups of papers are introduced by editorial comments that place the material in the proper context and perspective. The editor himself translated many of the articles. The volume includes 39 complete papers or excerpts from the works of Aristotle, Plato, Hero, DaVinci, Galileo, Newton, Leibniz, the Bernoullis, Carnot, Gasendi, Lavoisier, Hamilton, Mayer, Joule and other distinguished thinkers who contributed to the development of the concept of energy. They are an excellent collection of seminal ideas from which "the concept that has unified our understanding of experience" originated. And they compose a complete and representative series of the concept's history.

The editor has scrutinized and correlated these papers into a unified whole by using the criterion of "constancy in the midst of change," which he regards as the key idea that characterizes both the practical and the philosophical meanings of energy.

But "constancy in the midst of change" provides neither an explanation of the popular usage of the word energy nor a scientific definition of the concept of energy.

Constancy or Degradation?

The popular usage of the word energy refers to something that makes electric lights work, automobiles run, and factories produce consumer goods — that is, to the capacity of certain material bodies to perform useful tasks. This usage represents what scientists and engineers call availability, available energy, or available work — a concept related to both energy and another inherent property of matter called entropy. But availability can be

easily lost: for example, when energy is transferred from one material to another (as in a heat transfer from hot gases to cold gases), or while matter changes from one condition to another (as in the change of a cold fuel-air mixture to hot products of combustion). In other words, availability is lost when the transfer of energy or change of condition involves irreversibility. Nevertheless, availability is an attribute of matter which provides us with the capability to do productive work. And to secure this capability we consume a relatively large fraction of our income both at home and abroad.

So, the popular usage of the word "energy" does not satisfy the criterion of "constancy in the midst of change" but rather that of degradation in the midst of our efforts to capture energy's usefulness.

On the other hand, the thermodynamic definition of energy differs from the popular meaning of the word: it is more general than the definition given in mechanics and it cannot be derived from the principle of invariance in the presence of change. The magnitude of this energy differs from that of the corresponding availability, the difference being determined by the value of the entropy.

A Critical Distinction

The editor introduced his criterion in response to the question: "Must you pursue a whole course of university physics with its awful array of mathematical symbolism in order to understand what energy means, how it is measured, and the reason for its overwhelmingly important role in human life?" Many teachers have shared Professor Lindsay's concern for a simple way to explain "energy," yet none have found a definition as inclusive and encompassing as that offered by the first law of thermodynamics. In essence, this law holds that "energy is a property of matter (a state function) which can be measured by doing work on that matter (by connecting that matter to weights that are lowered or raised between two fixed levels in a gravity field)." No doubt, this is a complicated definition, but without an understanding of the terms matter, system, state, property, and work the scientific meaning of energy cannot be expressed. These prerequisites are somewhat analogous to the prerequisites of other familiar terms (for example, instantaneous velocity or acceleration) for which a scientific definition cannot be given until other concepts, such as space, position, time, and derivative are understood. Although common-sense examples can explain availability, no obvious, intuitive, or

everyday-life explanation exists for energy itself.

Because its operational definition involves work, energy is often misinterpreted as the capacity of matter to perform useful tasks. This interpretation can be easily dismissed, if we consider as an example the air around us. It has lots of energy and yet has no ability to heat our homes or feed our growth. More fundamentally, any amount of energy can be transferred to matter by doing work on it, but the availability of this energy depends on how the final condition or state of the matter in question is reached. If the final state is reached without irreversibility, the capacity to perform useful tasks — the adiabatic availability — will be equal to the energy transferred. However, if the final state is reached with irreversibility, this capacity will be smaller than the energy transferred, and may even be equal to zero.

Whereas the definition of energy as a state function that can be measured by work does imply "constancy in the midst of change," the idea of constancy or conservation neither defines nor implies the existence of energy as a property of matter. Money in a safe is conserved and yet is not energy. As extensively discussed in several papers in the book, momentum is conserved and yet is not energy. The work involved in the measurement of energy need not be related to a change of a quantity that is conserved and is a property of matter. In other words, the definition of energy is the essence of the first law and, to date, no one has been able to derive this law from other principles of physical science, including all the invariances resulting from the symmetry transformations of mechanics. The reason, of course, is that other principles cannot cope with entropy as a property of matter whereas the first law can.

The distinction between availability and energy — its scientific and philosophical implications aside — is of paramount importance to our concerns about exhaustible fuel resources. Several studies have disclosed that the U.S. economy uses only 8 per cent of the availability of all the fuels that it consumes. By making better use of availability, namely by increasing the efficiency of end-uses of fuels in our economy, we will be able to perform many more useful tasks in our society without diminishing the amount of energy that we can afford to buy.

The book is thorough and thought-provoking. But readers should be forewarned not to expect an elaborate explanation of either the popular usage of the

word energy or the contemporary scientific definition of the term.

Elias P. Gyftopoulos is Ford Professor of Engineering at M.I.T. □

A Key to the Corporate Washroom

The Managerial Woman

Margaret Hennig, Anne Jardim
New York, N.Y.: Doubleday and Co.,
1977, xvii + 221 pp.; \$7.95

Reviewed by Melissa M. Weiksar

There's a kind of survivor guilt we northeasterners feel living in Texas — we refugees, so branded each time we say "y'all" with a Boston accent. I'm a member of one of those 5,000 households who move to Houston each month. To state my motive in its crudest sense: I came here to make money.

First, there's the culture shock and compromise. If you live out by N.A.S.A. and work 20 miles yonder in one of Houston's three downtown districts, you've got to be on the freeway by 6 a.m. to avoid traffic jams (one year ago, it was 6:15). You watch all the cowboys in their pickup trucks, and come to crave the morning report from Port City Stockyards. You're condemned a heretic if you dislike beef. Your favorite yogurt is made in Miami; even if you find the brand in Houston, there's no prune whip. The *New York Times* takes three days to get here, but by then history is repeating itself anyway.

I work for a major oil company, developing and maintaining computer programs for our international production engineers. I'm the liberal, East-Coast-establishment, freeze-in-the-dark, renegade-Yankee, M.I.T.-women's libber.

One day at the office, I pulled my *Times Book Review* from its plain brown wrapper and noticed an ad for *The Managerial Woman*. Pining for intellectual stimulation, I bought it. I skimmed Chapter Four: the authors' Oedipal theory appears as if only to prove that someone passed Psych 100 at Wellesley. And remembering that the authors deal only with the milieu of middle management, I extrapolated carefully. I haven't been able to keep a straight face in the conference room since.

The book's appearance coincided with a series of irksome meetings I'd been attending. It bothered me to encounter interna-

tional corporate managers who didn't even appear competent, and I needed an explanation. I'd heard "good old boys" rumors. And I suspected from the way these men talk to one another that a certain bond comes only with the mud, sweat, and years they've invested in boring the earth for petroleum.

Mss. Hennig and Jardim tell me that the big boys work like the little boys play. Even if everybody hates Sonny, it takes 11 kids to make a team. Years later, off in the sands of Libya, Sonny becomes your 11th-hour teammate and drinking buddy — just as you tolerated him as a brat on your football squad. Another hangnail: maybe Simon is simply your friend; he doesn't make you win, but at least he doesn't make you lose. Because he's your friend, you always find a place for him on your team.

Now for us girls (sic). Our childhood play tends to be intimate, so likes and dislikes can dominate in the absence of a higher goal: "You don't like my doll's hair color so you're not my friend any more." This play trait emerges as personal pettiness in big girls, and supposedly dooms us in big business.

The Managerial Woman alerts us that a young man entering business doesn't study the personalities of those around him, but rather the personal ties: is this environment supportive? He sees his work as a step in a career, and will transcend personal likes and dislikes. He is much more concerned about the buoyancy surrounding him than his ability to sail with technical competence: the result of team sports, we're told. Further, little boys expect from an early age that "someday" they will have to earn a living. Little girls, even now, still perceive a scapegoat: they figure, for better or for worse, they can always find a male to support them.

We're told that the women who enter business are too uptight about their personal qualifications. But how else do we make an impact? After all, males are naturally accepted in business: they essentially have to prove they can fail before being thrown overboard. Females must prove success to come on board in the first place. But, alas, it's not our credentials but our risk-taking that will help us succeed. And again, we're victims of breeding. Risk for little boys means adventure and excitement; risk for little girls means you'll get your dress dirty, or you'll fall and hurt yourself. Therefore, the authors feel, women have been taught to view risk as a potential for loss, not a possibility for gain.

Further coupled with risk-aversion is a

Study 40 years at the B school.

woman's traditional commitment to a job, but not a career. Because we value our personal lives, we give our best from nine to five, Monday through Friday. But executives, we're told, must learn to let off-hours commitments slide when long-term goals are at stake — indeed, must learn to recognize such situations. If getting that report out by Tuesday makes you more visible to the company president, the short-term sacrifice supposedly pays off.

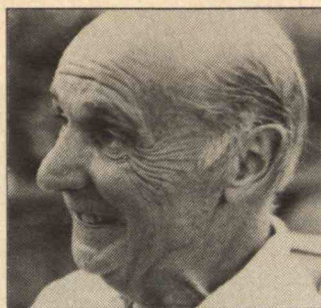
What about the 25 women whom Mss. Hennig and Jardim interviewed to derive their thesis? These women tended to be eldest daughters, raised as a first-born son might have been. They preferred adult to peer circles as they grew up. Yet most entered the business world as secretaries. Loyal to an individual who was working his way up the ladder, they ascended in parallel.

The authors insist that junior executives of either sex must find such mentors. However, they leave feminists and other idealists without much hope. They claim that although the upper echelon male establishment may be distasteful at first, the aspiring female manager will be seduced by the challenge. She becomes convinced of the propriety of the status quo and in the process loses her humanist zeal. I find this prognosis disappointing, if not disillusioning.

Still, my peers and I talk as if we're going to be managers someday. Mss. Hennig and Jardim tell us all to imagine that in aiming for corporate upper echelons, we're headed for a foreign country. (Compared with Houston, Dubai must be child's play.) Naturally, we'd read up on the language, customs, and geography of the place. Should we not similarly prepare when embarking on the journey of a career? Where are our maps to the mountain tops? Who is our interpreter of the strange customs we observe? How do we learn what questions and behavior are taboo? None of my formal schooling taught me what to expect in the business environment. The emphasis: excel in academics, and the jobs will fall naturally. Maybe. But careers are not so apolitical and fortuitous.

Some analysts believe that the wisdom of survival in business is imparted only over the flush of a urinal. Mss. Hennig and Jardim don't mention integrated lavatories, although in my company the same key opens either gender's washrooms. An omen?

Melissa Weiksnar is an engineering technician for Continental Oil Company and a 1976 graduate of M.I.T. □



The late F.J. Roethlisberger was one of the most distinguished teachers and researchers Harvard Business School ever had.

His concept of the business firm as a social system paved the way for the field of study variously known as interpersonal communications, human relations, and organizational behavior.

This is his candid, and often witty, account of his 40-year career at the B school.

Whether your field is business, education, or government — if your work involves people, his book is for you.

The Elusive Phenomena

An Autobiographical Account of My Work in the Field of Organizational Behavior at the Harvard Business School

F.J. Roethlisberger

George F.F. Lombard, Editor

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Letters

Continued from p. 3

(ingested substances which have been found to be carcinogenic are metabolized). Similarly, studies in monkeys and other species have been favorable to saccharin. The unfavorable information is contained in the two very questionable Canadian studies — the previously discussed rat study and one concerning humans.

Dr. Nisbet failed to note, in citing the one "positive" Canadian epidemiology study, that it showed a *decrease* in bladder cancer risk for women who use saccharin. He also failed to note that no connection was found between saccharin usage in dietary foods and beverages and increased bladder cancer.

Tens of millions of diabetics and people concerned about their weight, may well find Mr. Nisbet's statement that "the public probably lacks the judgment to make decisions on complex issues" more difficult to swallow than saccharin.

Mr. Kellen is President of the Calorie Control Council, an organization of over 60 manufacturers of low-calorie and dietary products. — Ed.

Dr. Nisbet replies:

The Canadian study in which saccharin

was shown to be carcinogenic in rats is summarized in *Science*, 197: 320 (July 22, 1977). Although the experiment also included a test of OTS, pure saccharin was fed to two generations of rats. Contrary to Kellen's statement, there were adequate controls for both sexes of both generations.

The remainder of Kellen's comments are trivial, irrelevant, misleading, or wrong. In my article, I argued that one reason why the public lacks the judgment to make decisions on complex issues is because it is barraged with misinformation by interested parties. Kellen's letter admirably illustrates my point.

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Transportation

Diesel Four Wheelers: Can We Take the Rap for Fuel Economy?

The massive diesel powerplants in heavy trucks, such as the GMC General (above) typically run for 300,000 miles before having to be torn down and rebuilt. Not only are the big diesels sturdily built, but efficient filtration systems protect the engine against the entrance of dirt from the air, fuel, lubricating oil, and coolant. (Photos: Len Phillips)

For Europeans, gasoline has long been a luxury item. So for many years fuel-miserly diesels, which don't burn expensive gasoline, have been the engine of choice for many buyers of Mercedes-Benz and Peugeot automobiles. Even Volkswagen now offers a diesel engine in its Rabbit. And, for the first time, this year U.S. auto manufacturers are offering diesel

engine options in new models: GMC and Chevrolet, in light-duty half-ton trucks; Cadillac, in its Seville; Oldsmobile, in full-size passenger cars and station wagons; and International Harvester, in the four-wheel-drive Scout.

Automakers are cautiously introducing the diesel option as one strategy to meet the two goals set by the U.S. Environmen-

Three new diesels: from left to right, the GMC General, GMC pickup truck with diesel option, and Oldsmobile 98 with diesel option. The E.P.A. rates the pickup at 23 miles per gallon overall; the Oldsmobile at 24 miles per gallon overall.

tal Protection Agency (E.P.A.) for all lines of cars sold in the U.S. in 1985: they must achieve 27.5 miles per gallon of fuel, and extremely low emissions of carbon monoxide, hydrocarbons, and nitrogen oxides. The automakers are finding that sophisticated ignition systems, catalytic converters, and other hardware added to their gasoline-burning engines to meet E.P.A.'s interim mileage and emissions regulations have added complexity and have helped boost retail prices on American cars high enough to scare many buyers away.

The new automobile diesel engines need none of these expensive innovations to meet present mileage and emission limits. But their heavy weight, high manufacturing costs, and sluggish performance have until now relegated diesel use in U.S. over-the-road vehicles to long-haul, heavy-duty trucks. If the newly designed small diesel engines can overcome these problems, they may stabilize engine manufacturing costs — and “sticker” prices — and win back customers lost to the foreign car market.

Ads for the American-made diesel-powered cars proclaim fuel economy, minimal maintenance, long engine life, smooth operation, and innocuous exhaust emissions. Some of these claims are substantive:

□ Diesel engines are very economical to run. They use about 25 per cent less fuel than gasoline engines of the same power, according to Cecil Warner, Professor of Mechanical Engineering at Purdue University. Diesel fuel is higher in energy content by about 15 per cent than gasoline, and the efficiency of the diesel design is inherently slightly greater than that of a gasoline engine.

□ Diesel engines should require less maintenance than gasoline engines. They use fuel injection rather than carburetion and ignite their fuel solely from the heat produced by compression, eliminating spark ignition systems entirely. Thus, the “tune-up” is virtually unnecessary and periodic maintenance consists only of cleaning and adjusting the fuel injection system and changing oil and oil filter regularly.

□ Diesel engines tend to last longer than gasoline engines. They are built sturdily to withstand the great stresses of compression-ignition. The ratio of total cylinder volume to combustion chamber volume, called the compression ratio, of diesel engines is typically over 20:1, compared with about 8:1 for today's gasoline engines. When a piston moves rapidly to its uppermost position in the cylinder of a diesel engine, great heat and pressure are



created in the combustion chamber, igniting the fuel-air mixture — and dictating the great strength and concomitant longevity of engine parts.

□ Diesel engines in the new cars and light vehicles are acceptably quiet from the interior of the vehicles. Effective sound proofing, which lines the engine compartment, insulates passengers from the noise of the powerplant.

□ Although diesel emissions have a peculiar, sour smell, “The fumes you don’t smell in a gasoline engine are undoubtedly more harmful to you,” says Professor Warner. For not only is diesel fuel — and exhaust — free of lead, but exhaust emissions do not include significant amounts of carbon monoxide, the odorless killer in gasoline engine exhaust.

However, diesel owners will still have to contend with relatively sluggish performance, while enjoying the economy of their vehicles. The poor performance is no mystery, says Robert H. Borcherts, an engineer with Ford Motor Co., one auto company that has so far steered clear of making a diesel-powered car. Some of the fuel economy of a diesel comes from a trade-off for poor performance, he reported at the annual meeting of the American Association for the Advancement of Science. Thus, diesel cars accelerate less rapidly than do gasoline-powered cars, and cruising speeds take a little longer to reach — a factor to be considered when entering busy freeways.

Obtaining service also may frustrate new diesel car owners. Mechanics who are familiar with gasoline engines will need time and study to develop similar levels of expertise with the injectors, pumps, and adjustments of diesels. At present, a typical neighborhood mechanic would probably be unable to properly maintain, let alone repair, the fuel delivery system on diesel engines.

Unlike gasoline engines, diesels do not develop enough vacuum to run power brake units and accessories such as heater controls, air conditioning controls, and cruise control units, which all are powered by vacuum servos. To solve the vacuum problem, General Motors has added two devices to their passenger-car and light-duty truck diesel engines. A small mechanical vacuum pump supplies accessory servos and a hydraulic brake booster is used in conjunction with the power steering pump. The addition of these devices somewhat weakens the diesel's claim to extreme simplicity, and creates two novel sources of potential failure.

While time and effort may cure some of the ills of diesel automobiles, some of the engine's inherent characteristics may make them hard for Americans to accept.

Diesel engines are mechanically noisy. The soft whirring and muted hissing of a modern gasoline engine are euphonic in comparison with the knocking of even the most refined diesel. The noise is caused when the fuel-air mixture explodes inside the combustion chambers. Because the fuel-air mixture is squeezed about twice as hard as in gasoline engines, great stresses build up and relax in fractions of a second, causing engine parts to vibrate. The vibrations are transmitted throughout the engine, and are heard as “diesel rap,” which can disquiet the unprepared.

Efforts to control annoying diesel rap follow two general paths. Current practice is to line engine compartments with materials that muffle the sounds. But the rap is quite audible outside the vehicles. A much preferred alternative is to alter the basic design of the engine to stop the noise at its source inside the powerplant, say Richard H. Lyon, Professor of Mechanical Engineering at M.I.T. and Richard G. DeJong of Cambridge Collaborative, a firm of consulting engineers. Strongly criticiz-

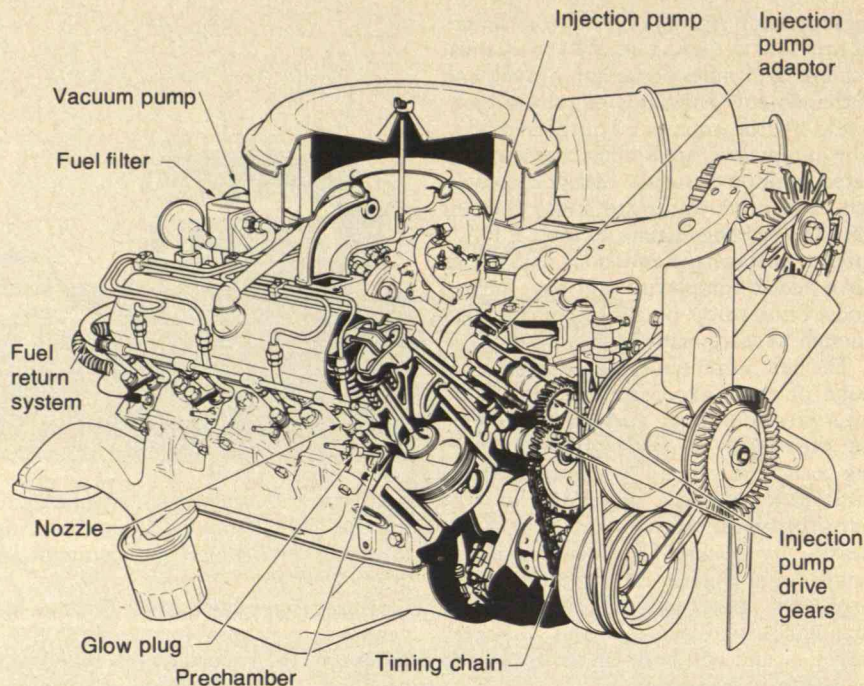
ing "band-aid," "add-on" noise control methods, they have designed a new kind of crankshaft bearing which reflects much of the vibration back into the engine before it propagates through the air as noise. Their "constrained layer" bearing ring sandwiches a 0.5-mm-thick silicone rubber layer between the engine block and the bearing metal. A four-cylinder test engine constructed with a set of these bearings was about 20 dB quieter between 2,000 and 4,000 Hz — the predominant frequency range of diesel rap — than when equipped with conventional solid metal bearings. They emphasize that the effects of their bearing design on "shaft instability" and "performance life" still require improvement. So for now, they say, diesel auto owners "will be forced to live with the unsatisfactory limitations of band-aid noise control."

Diesel exhaust, while essentially non-toxic, does include troublesome nitrogen oxides and hydrocarbons. Sunlight acting on these gases causes photochemical smog, and in addition, inhalation of nitrogen dioxide can lead to "... increased rates of acute respiratory illness, and possibly a higher incidence of chronic effects," according to R. A. Ziskind of Science Applications, Inc., in Los Angeles. Speaking at the Fourth Joint Conference on Sensing of Environmental Pollutants in New Orleans last winter, he pointed out that those most at risk would be people with pre-existing respiratory or heart ailments. This warning is especially significant in light of Dr. Ziskind's detection of serious leaks in exhaust systems of a large, well-maintained fleet of diesel trucks. He reported that one-third of the truck fleet accumulated more than one part per million of nitrogen dioxide — the threshold limit value of the National Institute of Occupational Safety and Health. The greatest concentrations accumulated in cabs of trucks with exhaust outlets near the road, like those in passenger cars, so that the need for meticulous inspection of diesel exhaust systems certainly cannot be ignored.

Starting a diesel engine in cold weather can be something of an adventure, and success is not guaranteed. Compression, unable to raise the temperature within chilly combustion chambers high enough to cause ignition, must be augmented by "glow plugs," resistance-wire devices resembling spark plugs. But these require a significant amount of electrical power so dual-battery systems are usually provided as part of a diesel "package." These batteries must also provide enough energy to the starter motor to spin the engine

The new lightweight diesels from General Motors have a unique combustion chamber configuration — a small prechamber into which fuel is injected and heated with a glow plug before the engine is spun by the starter motor. The glow period "can range from a few seconds on a warm day to 60 seconds

or more at sub-zero temperatures," according to Oldsmobile. The rotary-type injection pump performs the role of both the distributor and carburetor of a gasoline engine, by timing and metering the fuel delivered to each cylinder.



smartly, but this task is made difficult by the increased viscosity of lubricating oil in cold temperatures. A driver accustomed to starting up a gasoline engine and driving away in a matter of seconds will have to adjust to a several minute delay to pre-heat, start, and warm up a diesel. Particularly in cold winter climates, weak batteries and faulty charging systems will be intolerable.

Many diesel owners fill up their tanks at truck stops that cater to the big cross-country diesel semi-trailers. Finding in-town diesel fuel outlets can be a challenging quest, especially in unfamiliar areas: as a rule, gasoline stations do not pump diesel fuel. Most gas retailers have just completed installation of new facilities for unleaded gasoline, and unless the demand for diesel fuel mushrooms, they won't soon add expensive diesel fuel storage tanks and pumps as well. For land-starved urban gas stations, adding diesel-fuel service may be all but impossible. So, until diesel fuel outlets proliferate, it is entirely conceivable that a diesel automobile could lose its fuel efficiency advantage in repeated long treks to fill 'er up. — L.A.P. □

Can Gas Guzzlers Learn to Sip?

By 1985 the fuel consumption of automobiles sold in the U.S. is mandated by Congress, through the U.S. Environmental Protection Agency, to decrease by 33 per cent — from today's average of 18 miles

per gallon to 27.5 miles per gallon. An obvious response for industry would be to base new car designs on existing cars, including diesel-powered models, which now meet or exceed that economy goal. But the U.S. automobile industry is opting for additional strategies, in which new technology will reduce fuel consumption with fewer compromises on the size and style of cars to which Americans are accustomed.

One basic strategy will be to reduce weight. A 1 per cent weight reduction can yield 0.17 to 0.75 greater fuel efficiency, depending on other possible modifications.

But fuel consumption also depends on engine and drive train efficiency, rolling resistance, and aerodynamic drag. Improvements in these areas are on Detroit's current agenda.

Four engineers from Ford Motor Co., R. H. Borcherts, H. L. Stadler, W. M. Brehob, and J. E. Auiler, told members of the American Association for the Advancement of Science last winter that the efficiency of the internal combustion engine, now about 25 per cent, could be significantly improved. Greater engine output, permitting smaller displacements and concomitant decreased fuel consumption, could be achieved by raising compression ratios, reducing engine and drive train friction, and recovering energy from exhaust gases, they said. But the first of these options is constrained by anti-pollution systems and the octane rating of available gasoline; the second is hard to

A hypothetical automobile envisioned by Ford Motor Co. engineers would weigh 3,700 pounds, be powered by an engine displacing 250 cubic inches, and would have an automatic transmission. It would travel between 24 and 32 miles per gallon of gasoline if the engine could be turned off

during braked deceleration and when the vehicle was stopped. The version at Y has 40 per cent less drag and 60 per cent less rolling resistance than the version at X. Compare 1978 production car weights and operating efficiencies.

achieve because engine and drive train friction is already quite low; the third promises sizeable gain in output, but requires some fairly complicated hardware.

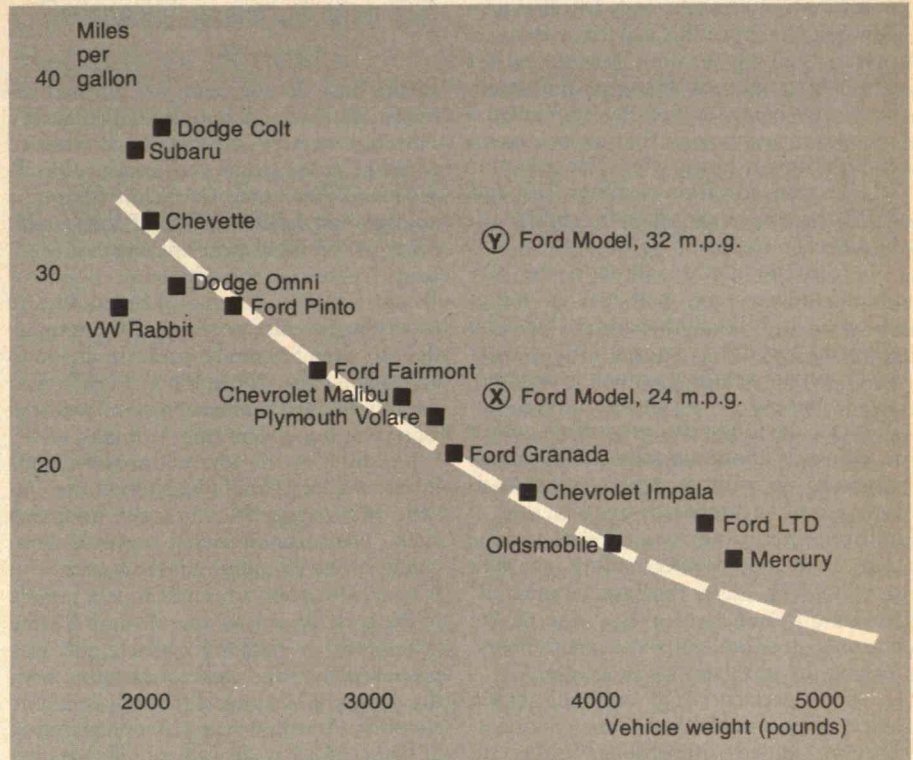
Reduced rolling resistance is mostly a matter of tires. Today's radial tires have 20 per cent less rolling resistance than bias-ply tires, and one newly-developed radial tire for light trucks will do even better. Until now tire makers were caught in a dilemma: further decreases in rolling resistance could be obtained only by increasing tire inflation pressure. The higher tire pressures cut rolling resistance and boosted fuel economy, but caused a rough ride and accelerated wear around the center of the tire tread area, to say nothing of increasing the stresses put on suspension components. A new development about ready for the market promises to break the tire pressure barrier comfortably — an easy-rolling elliptical radial that meets the industry's standards of riding quality when inflated to 50 pounds per sq. in.

Aerodynamic drag reduction is a matter of compromise between passenger comfort and streamlining. The amount of drag depends on the shape of a vehicle, its frontal area, velocity, and air density. A dimensionless number called the drag coefficient, which combines empirically-measured drag force with the above parameters permits automobile engineers to predict mathematically the drag of a vehicle at various speeds, and to compare the drag of one vehicle with another.

The French Citroen designed in 1973, with a drag coefficient of 0.35, is the most aerodynamic of modern production sedans; most American sedans are in the 0.5 range, with some station wagons up to 0.7. A Ford Granada, with a drag coefficient of 0.55, has an aerodynamic loss at 40 m.p.h. equal to the gain in rolling friction achieved by its radial tires.

To reduce drag, designers will minimize turbulence-causing protuberances such as headlights, bumpers, mirrors, and door handles; to reduce frontal area they aim for the sloping hoods and windshields characteristic of sports cars, but still commensurate with visibility requirements. The Ford engineers predict future drag coefficients of 0.3 to 0.35 to be optimal for American cars if the size of passenger accommodations is not to be reduced. More severe changes tend to add unacceptable length, mechanical complexity (headlamp doors are good streamlining, but require failure-prone mechanical controls), and weight.

Reducing weight remains the single most important strategy for increasing economy. The power required to acceler-



ate a car — or any other object — is directly proportional to its mass at ordinary speeds; and if there is to be no compromise with Americans' demands for snappy acceleration and high-speed hill-climbing (to a considerable extent, legitimate concerns in terms of safety and utility, said the Ford engineers), designers must turn major attention to reducing vehicle weight. Here, for a change, the benefits compound: reducing the weight of a car body makes possible additional weight reduction in the suspension components and frame, and yet another in brakes and engine. The pound-paring results can be "dramatic," said the Ford team.

By 1979 Ford will have a full-size prototype sedan, which will weigh in at 2,700 pounds — some 1,250 pounds or 30 per cent lighter than the production cars Ford will then be selling. The body and frame of that prototype will be largely made of graphite-epoxy composites and aluminum and its fuel economy will be up some 30 per cent, with no change in performance.

But it will be only a prototype. As noted in this section last month (see "Composites: Strong, Light, and a Heavy Price Tag," *March/April*, pp. 25-26), uncertainties about the cost, manufacturing techniques, damage and weather resistance, and repairability of advanced composites remain unanswered. — J.M. □

Railroads: Policy Now, Technology Later

Research could have saved the railroads a half century ago, but now the resolution of their plight depends less on technology than on government and management.

Think of the revolutionary changes in the business of moving ideas in the past half-century — from AM radio to color television; from manually-switched telephones to electronic and digital switching; from wires to wireless to optical to satellite transmission.

The revolution in communication was born in far-sighted fundamental research in electronics and optics, the outcome of which — solid-state devices, lasers, digital computers, and broad-based optical transmission — could not have been foreseen by its proponents. Neither government regulation nor economic depression could halt its inexorable progress.

There never was a comparable commitment to long-range research in the business of moving things — instead of words — from place to place. We're stuck with the railroads as they are, hardly changed — except for superficial "fixes" like substituting computers for chalk-wielding yardmen and diesels for steam — since the 19th century.

These arguments are used by Sherwood C. Chu of the U.S. Department of Trans-

portation's Research and Development Division to support his call for systems research seeking basic alternatives for handling freight. So many current problems are being solved by incremental changes in technology that no one seems to be taking a longer view. He asked an M.I.T. transportation seminar last fall. "Will there be anything on the shelf to use in a decade or two?"

In contrast to the railroads, the telephone industry has had lots of things going for it in the 20th century, Mr. Chu admits: corporate integration, a very rapid and unexplained growth in demand, and somehow "a psychology which encourages the long view, an attitude which is optimistic about the value of long-range research." In contrast, American railroads today are encumbered by a series of millstones, and they're in deeper trouble than their bookkeepers admit to their stockholders, says Professor James R. Nelson of Amherst College, one of the nation's leading railroad economists. Among the most serious problems:

□ Simple geriatrics. The railroads are the oldest major industry on the continent. They're saddled with obsolete real estate and with proliferated rules and unions.

□ Declining demand. Because railroads cannot comparably reduce expenses, reduced demand simply means reduced options. Dropping freight cars off a train hardly reduces at all the cost of running the train; eliminating a train hardly reduces at all the cost of maintaining the roadbed for the rest of the traffic on it.

□ Fragmentation. Too many of the railroads' resources "... go into civil war instead of into creative management," said Professor Nelson. Consider, for example, the adjuster for an eastern railroad that delivers damaged cargo from the west. The adjuster is less concerned with the amount of the adjustment than he is with keeping his own road off the hook.

□ Capital shortages and constraints. It's easier to raise new money for rolling stock than for line maintenance, and railroad managements find their hands tied because they cannot use scarce new capital for what most needs to be done.

Fixes for these problems have nothing to do with technology, short- or long-range. But that should not distract management from pursuing a long-range technological goal — the search for "a collection of systems which may be useful under certain future conditions"; and as it mounts this search management's success will depend on keeping an open mind about what conditions may prevail and which it wants, says Mr. Chu. — J.M. □

55 m.p.h. on a Bicycle?

In the past decade man has reached the moon, flown a pedal-powered aircraft in a closed one-mile circuit, and climbed Mount Everest from every conceivable direction. What next? Dr. Allan Abbott, a young physician from Dana Point, Calif., a renowned high-speed bicyclist who appears twice in the *Guinness Book of World Records*, has now offered \$2,500 to any single rider or team who can break the national 55-m.p.h. speed limit, or to any single rider who can pedal faster than 54 m.p.h. in a human-powered vehicle. Can it be done? Dr. Abbott thinks so.

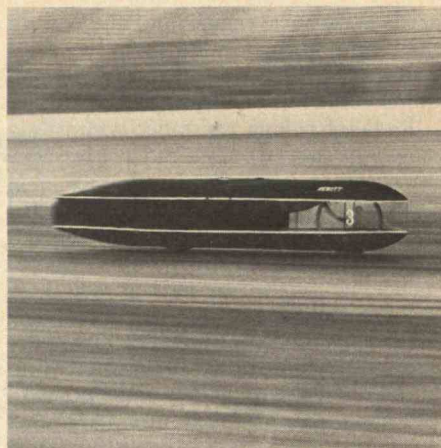
Recently, at the International Human-Powered Speed Championships at the Ontario Motor Speedway in California, two slick, streamlined pedal-powered machines broke 49 m.p.h. for the first time in history. Dr. Abbott himself rode a bicycle of his own design at over 48 m.p.h. The fastest vehicle had four wheels and was propelled by hand and foot cranks with the rider pedaling furiously on his stomach. Another was a standard racing tandem bicycle. In all of the fastest machines the riders were completely enclosed in light, sleek, streamlined plastic shells.

At near 50 m.p.h., with wind almost hurricane force, streamlining is essential if a human power plant is to be used. It may seem easy to win the Abbott Prize by achieving a speed only 6 m.p.h. over what has already been done. However, with the present generation of machines, cyclists would have to expend 30 to 40 per cent more energy at 55 m.p.h. than they would at 49 m.p.h. To do this riders would have to put out about 1.5 horsepower. Obviously, then, to win the prize, many improvements must be made.

Dr. Abbott's offer is intended to stimulate technological improvement through competition in human-powered transportation. The California State Highway Patrol has promised to issue a complimentary traffic ticket to anyone who wins.

The rules are simple. Any configuration of pedal-powered machine is legal provided it has no stored energy of any kind. Springs, motors, flywheels, batteries, pressure cylinders, etc., are prohibited. The vehicle may have one or more riders in it and must cover a course 200 meters long with a flying start in 8.13 seconds or less. The course must be level and wind velocity less than 4 m.p.h. Electronic timing must be used. No towing or motor pacing is permitted. — David Gordon Wilson from The Tech □

Dr. Allan Abbott, who has pedaled this custom-made bicycle to a speed of over 48 m.p.h., now offers \$2,500 as an incentive to other cyclists to surpass 55 m.p.h. (Photo: Chester Kyle)



Energy

Stemming the Third World's Rush to Oil

Ask the leader of even the smallest village in the Third World how to make life easier and more prosperous, and you will hear about jeeps, tractors, fertilizer, electricity, and diesel-powered mills. "Everywhere in the rural Third World," says James W. Howe, Senior Fellow of the Overseas Development Council, "plans are being made to start down a petroleum-based energy path."

But developing countries are already troubled by the rising cost of oil for their modern sectors, and an oil-based rural infrastructure would be an impoverishing, obsolescing — and therefore destabilizing — burden.

There are viable alternatives to a petroleum-based agriculture for the Third World, Dr. Howe told the American Association for the Advancement of Science last winter. A few countries with appropriate natural resources may turn to energy based on coal, geothermal, or large-scale hydroelectric systems. But the sun is the important, universal source, said Dr. Howe, and already some developing countries are effectively putting modern applications of solar energy and other "alternate" energy sources to work in agriculture. Among them:

□ Direct collection of solar energy is also a promising strategy for rural areas. Although they are relatively expensive, solar photovoltaic cells are appealing because virtually no technology is required to operate and maintain them. Conventional solar flat-plate collectors, which can produce heat to dry crops, warm or distill

water, and refrigerate food, could be built from local materials and would require little skill in maintenance and operation.

□ In the Peoples' Republic of China some 60,000 mini-hydroelectric generators — units of between 3 and 50 kilowatts capacity, operating on small streams and in front of simple dams — are now in use. In the U.S. such units would cost only \$5,000 to \$10,000 each; the cost in China may well be considerably less.

□ Wind machines are now known throughout the agricultural world; in Ethiopia farmers assemble and use sail-bladed, wind-powered water pumps — an especially promising recent development.

□ Thousands of farmers in Korea, Taiwan, China, and India use simple systems for producing methane gas from agricultural and human wastes (fertilizer is an important by-product). A family with five head or more of cattle can fuel a small biogas unit, and larger units are practical for villages which collect waste from many small farms.

A study by a U.S.-Tanzania team in 1977 showed that solar-based power would compare favorably in cost with diesel-generated electricity in rural areas of that country. Farmers connected to the Tanzania electrical grid pay 0.88 shillings per kilowatt-hour, but the cost of electricity from a privately-run diesel generator is much higher — 2.3 shillings per kilowatt-hour. The costs per kilowatt-hour of solar-based alternatives were calculated as follows: mini-hydro, 0.26 to 0.97 shillings; wind, 1.5 shillings; flat-plate collectors (for cooling), 0.98 shillings. Electricity from photovoltaic cells now cost 11.6 shillings per kilowatt of capacity, but if the cost of cells is reduced by 1985 according to the U.S. Department of Energy's goals, photovoltaic costs will be 0.83 shillings per kilowatt in less than a decade.

Despite these fairly optimistic comparisons, Dr. Howe admits that the record of imported alternative technologies in developing countries is dismal — "Anyone who has traveled extensively in developing countries has come across the skeletons of windmills or the remains of abandoned biodigesters." The Overseas Development Council is now working with the Agency for International Development on a series of prototype projects to determine the real potential of solar energy for Third World villages and, "Some answers should be emerging within a few years."

On the outcome of these projects, Dr. Howe told the A.A.A.S., "... rest the hopes for improving the quality of life for a majority of the world's people." —J.M. □

Can We Cost Out the Regulatory Benefits?

The U.S. is in the midst of what J. Daniel Nyhart of M.I.T. calls a "regulatory revolution" — a change in the performance of our government as dramatic as that of the New Deal" nearly a half-century ago.

When once we regulated on an industry-by-industry basis — the Federal Power Commission for electrical energy, the Interstate Commerce Commission for transportation, for examples — now we regulate on a subject-by-subject basis — air and water pollution by *all* polluters, safety in *all* factories, noise by *all* noisemakers.

Can these new kinds of controls be made to work? Will they be worth their cost? Indeed, what *is* their cost?

Professor Nyhart identifies five kinds of costs: the direct cost to government to make, interpret, and enforce regulations; the direct cost to industry to comply; the indirect costs paid by consumers of regulated goods (the extra cost of a car with a catalytic converter, and then the extra cost of lead-free fuel for the car's lifetime); the cost of litigation to interpret or challenge regulations; and the costs in terms of income or opportunities foregone by industry because of delay and uncertainty in regulation.

The first of these is relatively easy to assess. Murray Weidenbaum of Washington University puts the cost to the taxpayer of major federal regulatory agencies in 1976 at \$3.8 billion; in 1972 there were fewer such federal agencies, and they cost only \$1.3 billion.

Every affected industry promotes its own estimates of its costs to comply with environmental and safety regulations; General Motors, for example, puts the figure at \$1 billion a year since 1974. But no one knows exactly what to add up or how to do it. A principal difficulty in this exercise, said graduates of M.I.T.'s Sloan School of Management who came back for a renewal of their classroom experience this fall, is that there is no obvious way to put a price on management's rising investment of time and energy.

For example, though most environmental control is accomplished by technology, most regulatory rulings are made by lawyers whose understanding of the technology is minimal. Their lack of understanding doesn't stop them from trying; "Attorneys are getting fascinated with engineering," said Robert C. Luscomb, Jr., of General Motors' Cadillac Division.

The cost of litigation is hard to know,

too. Professor Nyhart notes that the number of cases before U.S. district courts has doubled in a decade, those before courts of appeal has quadrupled. At least 10 per cent of today's cases are related to environmental issues, and perhaps as many again are related to other regulatory problems.

Though imperfectly measured, it's clear that regulation is costly to the U.S. economy. Professor Weidenbaum argues that government-mandated regulatory costs, which are passed on by various levels of producers and distributors ultimately to the consumer, have been a major factor in recent inflation, and some Sloan School graduates believe Professor Nyhart's "regulatory revolution" has contributed significantly to the new phenomenon of "stagflation." It's not that they necessarily oppose the new thrust of regulation, they insisted; they simply believe that as we calculate the benefits of reduced pollution and greater safety we should also understand their true cost to the economy and to each of us in it. — J.M. □

Cutting the Energy Dilemma to Size

What will happen when the lights go out on a shiftless world that is still arguing indecisively about how to deal with the apocalypse which overtakes it? No one can imagine, and that's why everyone wants the reassurance of a comprehensive energy policy — the sooner the better. But in the face of many conflicting options, all-encompassing energy decisions are not possible — and may not be wise.

The world's oil resources won't run out that way, says Professor Henry D. Jacoby, Head of the M.I.T. Energy Laboratory's Policy Studies Group. Think back to the "coffee crisis" of 1976: we knew, months ahead, of the great freeze that had destroyed crops in Latin America. No amount of planning could have prevented the resulting scarcity and high prices. But grocers' shelves were not bare. Some of us gave up that second cup, and others switched to tea.

The "energy crunch" will be like that; the "final" day when the oil wells suddenly run dry will be like a receding horizon, constantly moving ahead of us. Only one thing is certain, says Professor Jacoby, "constant pressure on price, beginning quite soon."

Coffee is not energy, of course. For most of us coffee is a luxury without

which life can proceed. But energy is a necessity. The endless debate about energy is a sign of the seriousness of impending energy shortages and price rises, and of "our inability to deal with the social consequences of the changes we must go through," says Professor Jacoby.

Because we are human, we project a simple scenario: on some future day the oil wells may run dry, but a simple solution will be possible — a comprehensive energy plan that reduces the ensuing trauma to mere inconveniences. But the plan is elusive, the decisions complex. Shall we relax environmental and safety constraints and burn more coal? Shall we concentrate on an energy-frugal solar-powered future? What about the flow of dollars overseas as we bring ever more oil from the Middle East? Shall we put all our money on the fusion reactor as the ultimate panacea? Or revive the nuclear age, with its hazards of safety and proliferation?

Because we find these trade-offs mind-boggling, suggests Professor Jacoby, we turn to new "solutions" like "soft" energy sources (Amory Lovins' confidence in "soft" energy is "an expression of the ultimate faith in technology," said Professor Jacoby) and to little details of big questions — for example, devising different prices for "old" gas and "new" gas, gas in intrastate and interstate commerce, gas used to turn turbines, gas used to heat homes, and gas used to heat schools.

We distract ourselves with fruitless tactical alternatives when the real lesson, says Professor Jacoby, is that we must reduce the complexity of our decisions and the number of our trade-offs, tackling alternative solutions one by one, each on the basis of its own merit. And we must be sure to give the market — the system of prices regulated by supply and demand — its rightful, helpful role. — J.M. □

Aerospace

Orbiter Peers into Venus' Clouded Past

Cloud-shrouded Venus is a close match to the earth in both size and distance from the sun, so imaginative minds never have had much difficulty in populating the planet with creatures of all sorts. However strange these fantasies might become, the truth that scientists began to discover in the 20th century is indeed stranger than fiction. When earth-based instruments

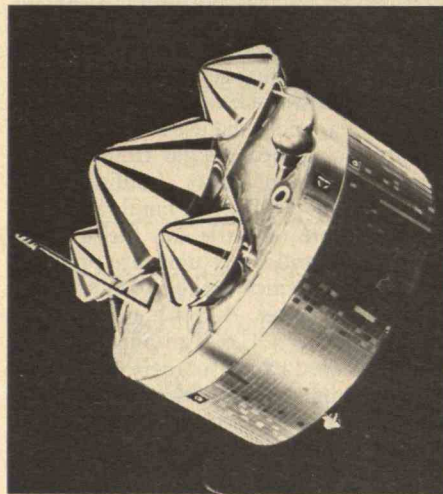
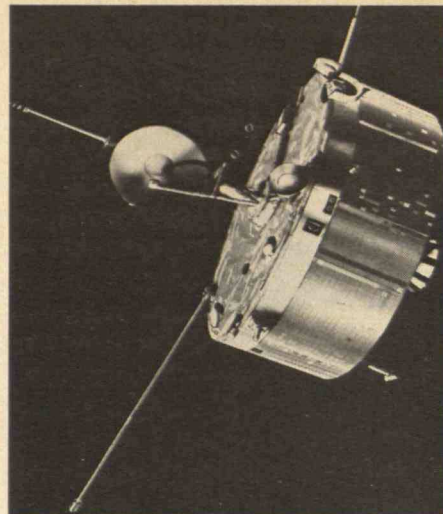
declared the surface temperature to be 325 °C in the mid-1950s, few astronomers believed the result until ten years later, when the U.S. Mariner and the U.S.S.R. Venera probes showed that the surface was even hotter. Now that more data are available, scientists ask how a planet so like the earth in many ways could evolve into such a different world.

For a world of clouds, radar has proved an invaluable tool. Radio probes of the Venus surface by the antennas of Arecibo, Goldstone, and Haystack reveal a cratered surface grossly similar to that of the moon and Mars. But even these giant installations are limited in their power to gather precise data: radar can look only at the face of the planet that is always presented to earth when the planets come close together, and earth-based radar provides accurate altitude measurements for only the limited area which belts the planet at its equator. Thus a full and accurate topographic map has yet to be drawn, and the exact shape of the planet is still unknown.

Data from experiments carried out by the Pioneer Venus Orbiter — scheduled for launch this month — are expected to fill some of these information voids. The Orbiter should be circling Venus by early December. It will carry a number of experiments designed to study the planet's surface and interior as well as its dense and mysterious atmosphere. The Orbiter will be joined by a "multiprobe" spacecraft, to be launched in August, which will measure various atmospheric characteristics.

The Orbiter carries a radar altimeter that can measure the distance from the spacecraft to the surface to an accuracy of between 50 and 300 meters. Radio tracking will enable scientists to calculate the position of the spacecraft with respect to the planet's center and derive the altitude of each examined surface location with simple arithmetic.

The altimeter, developed by a team of researchers led by Gordon H. Pettengill of M.I.T., will scan the Venusian surface from the spinning spacecraft once every 12 seconds. Each "glance" will yield readings from one or more small "footprint" areas — which will shrink to 8 by 12 kilometers at the spacecraft's closest approach to the surface. The system will also beam information about surface reflectivity and texture to earth. The spacecraft will orbit daily while the planet revolves slowly beneath it (Venus completes one revolution in 243 days): thus each orbit will trace a different path on the planet's surface. Eight months later the readings will form a grid covering the planet from 75° north to 50° south.



Pioneer Venus Orbiter (top), launched this month, will be joined by a "multiprobe" spacecraft (bottom), to be launched in August and scheduled to penetrate the Venusian atmosphere six days after the December insertion of the Orbiter into its orbit 60,000 kilometers above the planet. The multiprobe will measure various atmospheric properties, including pressure, temperature, and the size and density of particles in the clouds. Infrared-measuring instruments will determine how much of the heat absorbed by the atmosphere comes from the sun, and how much radiates from the planet's surface. Studies of variations in the telemetry signals themselves will enable three earthbound monitoring stations to determine through triangulation the velocities and positions of the probes and the "bus," which carries them, until they are released to plunge through the Venusian atmosphere and encounter winds. The largest of the four probes of the multiprobe spacecraft will be parachuted down to about 44,000 kilometers altitude, and will then free-fall to a point on the planet where the Venusian equator crosses the day-night terminator, about one-third of the way across the planet from the western horizon. Two of the three small probes will free-fall near the north pole, one in the daylight area and one in the night area. The third small probe will land near the south pole. (Drawings: N.A.S.A.)

The same radar will be used to take surface "snapshots" to each side of the orbital path. These pictures won't quite match the best taken from earth, but they will cover the unseen back of the planet and add to data already available for the front.

The altitude data should reveal continents and other large-scale topographic features — evidence that can be read to indicate that, like earth, moon, and Mars, Venus has a crust that has differentiated as it cooled into denser and lighter rocks.

Analysts will also look for evidence of faults or other tell-tale signs that Venus has large crustal plates like those that have moved to create the continents, mountains, and oceans of earth.

Looking at how many craters dot the surface may shed further light on the planet's history. If few craters are found, chances are that erosion from the corrosive winds or shifting of the Venesian crust have obliterated older craters.

From the altimetry readings will come the shape of the planet to a high degree of accuracy. One theory suggests that Venus once rotated more rapidly than it does now, but that it was slowed down by tidal pull from the earth. For the tidal forces to work, Venus must have sufficient plasticity to lose significant energy as the tidal bulge passes across the surface; in addition, rapid rotation might have created an equatorial bulge like that of earth, which might still be "frozen in." These features might be detected both by the altimeter and by concurrent study of the effects of Venesian gravity on the spacecraft's path. The tidal pull theory is already attractive because it might explain why nearly the same part of Venus always faces the earth at the planets' closest approach.

The orbiter will measure the magnetic field of the planet as well. Measurements up until now have indicated that Venus has very little, if any, intrinsic magnetic field. Other orbiter-carried equipment is designed to study the carbon-dioxide rich atmosphere, which contains such corrosive substances as hydrochloric and sulfuric acid. The cloud tops' yellow color is only one of many mysteries that still envelop the planet Venus. — *Mark James* □

MX: \$30 Billion for Parity?

A proposed system for making missile launchers mobile by putting them in tunnels is now entering the arena of public debate. At a recent M.I.T. seminar Professor Jack P. Ruina described the system, called the MX (Missile Experimental) Program, as a new level of deterrence

against nuclear war. The program, which may cost at least \$30 billion, is an escalation of the race to maintain arms parity with the Soviets.

The U.S. is committed to maintaining three independent systems for delivering nuclear warheads against the U.S.S.R. — aircraft carrying missiles and bombs, submarines carrying multiple-warhead missiles, and intercontinental ballistic missiles which can be launched from within the U.S., carrying multiple warheads. The theory behind this "triad" concept is that destruction of any one of these systems does not jeopardize the ability of the remaining systems to retaliate — a threat which presumably serves to deter a Soviet nuclear attack.

Each system is constantly being strengthened within the limits of S.A.L.T. agreements. For example, intercontinental ballistic missiles have been upgraded to carry more warheads and to be more accurate; bomber aircraft now approach their targets at very low altitudes with electronic jammers as protection against detection; the range and payload of submarine-launched missiles is increasing; and stronger — "harder" — concrete silos protect land-based missiles.

But it is simply not possible to build a silo strong enough to protect a launch vehicle against a direct hit by an enemy's nuclear warhead. Probability analysis shows that to maintain the integrity of our land-based missile system we must increase by nearly ten-fold the "hardness" of the silos in which missiles are protected for every two-fold increase the Soviets make in the accuracy of their missile delivery systems. And that's "a losing game," says Professor Ruina.

Two elements of uncertainty appear:

- The Soviets are improving the accuracy of their missiles.
- The enemy's use of multiple warheads on single missiles implies great destructive power, but actual data are unknown. (Two warheads aimed at a single target may destroy each other, and perhaps other nearby warheads as well, as they detonate. Without atmospheric testing, prohibited by the limits of the Test Ban Treaty, it is impossible to learn the technical details of this "fratricide" problem.)

So U.S. missile silos may soon be vulnerable (at least on paper) to Soviet attack, and the U.S. is faced with choosing among several alternatives:

- Negotiate with the Soviets a ban on new missile development to halt the projected improvements. (This is by far the best solution, says Professor Ruina, but is not on the agenda for S.A.L.T. II; it will

surely be considered at S.A.L.T. III.)

- Change strategy to permit launch of retaliatory missiles upon *warning* of an attack instead of on confirmation of one. ("Unthinkable," says Professor Ruina.)

- Renounce the "triad" policy, admitting that two independent systems for launching missiles — aircraft and submarines — are adequate as nuclear deterrence. ("We're not ready to think in these terms," says Professor Ruina.)

- Erect passive defenses around our missile silos — electronics to jam the electronic systems on board enemy reentry vehicles, even physical barriers against which explosives will be harmlessly detonated 1,000 or more feet from each silo. (We're not sure this is feasible.)

- Erect active defenses around our missile silos — more missiles to destroy all unknown intruders within a given area. (This looks to Professor Ruina to be politically "mischievous" at this time, since "active" defenses were banned under S.A.L.T. I.)

- Give land-based intercontinental ballistic missiles one capability which they now lack compared with aircraft and submarines: mobility. If he cannot know a target precisely, the enemy's increasing skill in guidance is defused.

The MX Program embodies the last alternative. Minuteman missiles, unpredictably and secretly shifted through "hard" tunnels 10 or 20 miles long, would become moving targets whose exact location would be unknown. There might be 300 tunnels, costing (by current estimates) \$100 million each — a \$30 billion program. That's expensive. In comparison, each Minuteman in its silo costs \$15 million; to install and maintain a Trident missile in a nuclear submarine for ten years costs \$60 million. Too, the \$30 billion estimate is subject to increase.

The high and uncertain cost is one reason for what Professor Ruina calls a "singular lack of enthusiasm" for MX. Another is the sense that this is an inelegant, brute-force solution that involves the Air Force in an activity — heavy construction — largely foreign to its high-flying tradition.

But despite its seemingly "bizarre" character, some aspects of the MX Program are attractive. Strong political and emotional arguments support the "triad" policy. The U.S. needs something with which to bargain with the Soviets in future arms control negotiations in order to limit future U.S.S.R. missile developments. And the mood of the nation may also require something with which to atone for the B-1 bomber's death sentence. — *J.M.* □

Enhanced Radiation Warheads, Alias the Neutron Bomb

George B. Kistiakowsky
Abbott and James Lawrence Professor of Chemistry,
Emeritus
Harvard University

Called Enhanced Radiation Warheads by their proponents, neutron bombs by their critics and the popular press, they are but low-yield variants of the same hydrogen bombs that were first tested nearly 25 years ago. The disclosure of the development of the ERW less than a year ago has generated a flood of publicity, some ill-informed or plainly biased. And so here I hope to review the technical, military and political issues which have led to the delay in ERW deployment into our tactical nuclear forces.

Neutrons as a Weapon

The uranium or plutonium in a fission (atom) bomb releases about 20 million times as much energy per pound of reacting material as TNT. This yield is usually expressed as kilotons (kt) of TNT equivalent. A kiloton — 1,000 tons — of TNT creates a huge explosion. In an accidental explosion in the harbor of Texas City, Texas, a freighter loaded with a type of nitrogen fertilizer (which was not then considered dangerous) killed several hundred people in nearby buildings and totally devastated the harbor and its vicinity. I estimate that 1947 explosion to be equivalent to less than 2 kt of TNT.

While the energy released by TNT manifests itself as blast, the energy from a fission explosion typically divides into about 50 per cent blast, 35 per cent heat radiation, and 5 per cent prompt ionizing radiation (mainly neutrons and gamma rays). The remaining 10 per cent appears as delayed ionizing radiation and heat from the fission products in fallout. A large fission explosion (tens of kilotons of TNT equivalent) does most of its damage by blast and heat radiation. The distance at which the blast and heat damage done by one bomb equals that of another varies roughly as the cube root of the ratio of their total energy releases.

As the energy of a fission explosion is reduced to one kiloton equivalent or less, the damaging effect of prompt neutron and gamma ray radiation becomes dominant. The range of radiation damage does not change as rapidly as the cube root of energy release. This happens because, for example, neutrons which are produced with very high energy (two million electron volt equivalent in fission, up to 14 mev in fusion reactions) travel quite far through matter. They will travel several hundred meters in air, for instance, before they lose a significant fraction of their energy. When the neutrons slow significantly, the rest of their energy dissipates relatively rapidly, and the neutrons are captured by some atoms.

A fission explosion started in the appropriate geometrical configuration can heat and compress a mass of heavy hydrogen isotopes (deuterium or a mixture of deuterium and tritium) to a state approaching that in the interior of



During World War II George B. Kistiakowsky had a major role in development of the atomic bomb. But now he writes an outspoken argument for "mothballing" a more recent product of nuclear weapons technology — the so-called neutron bomb. (Photo: Calvin Campbell)

stars. Under such conditions an explosively rapid fusion reaction takes place in which a pair of deuterium atoms form a tritium atom and a neutron, while a deuterium and a tritium atom combine and produce a helium atom and a neutron. This is the physics of a thermonuclear or hydrogen bomb explosion. In large thermonuclear warheads, the locus of the fusion explosion may be surrounded by a layer or "blanket" of ordinary uranium, which traps very energetic neutrons and undergoes fission itself. In this way a three-stage fission → fusion → fission explosion is obtained. This process can be amplified into those monstrous multi-megaton warheads that the U.S. and the U.S.S.R. tested prior to the atmospheric test ban treaty of 1963.

Up to 80 per cent of the released energy in the fusion reaction is carried away from the locus of explosion as the kinetic energy of the neutrons. More than ten fusion events are needed to release as much total energy as one fissioning uranium atom. In explosions of equal energy release, therefore, a pure fusion device would generate about ten times as many neutrons as would a pure fission warhead, and these neutrons would be more energetic.

The heaviest elements capture very energetic neutrons to undergo fission. But the lightest chemical elements are most effective in slowing down the neutrons. Thus a plate

As an addition to the United States' nuclear arsenal, the neutron bomb would be ineffective, excessively costly, and militarily provocative. And its deployment would be inhumane.

made of paraffin wax (containing 14 per cent hydrogen) slows neutrons more effectively than an equally thick iron plate, even though the latter weighs eight times as much. The body of a human (made up largely of water) is a more effective barrier than a brick wall of the same thickness.

In their slowdown, the neutrons impart their energy to the matter through which they pass. This causes the formation of charged particles (ions) and the breaking of chemical bonds — processes that are highly damaging to living cells. So nuclear weaponeers have speculated for many years about enhancing the military effect of neutrons in nuclear munitions.

The Birth of the Neutron Bomb

Dr. S. T. Cohen of the Rand Corp. claims to be the father of the neutron bomb, and the event took place about 1958. Since 1958, ERWs have been proposed and developed for several purposes. Their most recent incarnation was developed primarily for anti-tank use in Europe in a response to a three-to-one numerical superiority in tanks of the Warsaw Pact forces and a concern in N.A.T.O. councils that these would be used for a blitzkrieg attack on the West.

In 1960, the Atomic Energy Commission's Livermore Weapons Laboratory, at that time led by Edward Teller, lobbied hard in the Pentagon to establish military requirements for developing "pure radiation" tactical warheads. For these projects, they invented the code names of Dove and Starling. Dove and Starling were to explode without the assist of a fission trigger and therefore were to produce exceedingly small amounts of blast and fallout. I was then on President Eisenhower's staff, and recall a presentation given to a panel of the President's Science Advisory Committee (P.S.A.C.) by a Lawrence Livermore Laboratory official that (quite incorrectly) explained the bomb's effects. It was said that such a weapon, when exploded above ground, would kill everybody within a certain range nearly instantly but do no grave harm to anybody just a little further away. The Livermore proposal, notwithstanding this attractive claimed feature, did not fire Washington's imagination and was not put into practice.

The lobbying for Dove and Starling was a part of the effort to end the moratorium on nuclear testing that President Eisenhower had mandated in 1958. The moratorium, still in effect in both the U.S. and the Soviet Union in 1960, was then vehemently opposed by strong forces within the Atomic Energy Commission (A.E.C.), including its Chairman, John McCone, by Dr. Teller, by the Air Force brass (then the chief possessors of nuclear warheads), and by the Joint Congressional Committee on Atomic Energy.

The same basic technical concept was extended to much higher yields, referred to as the clean peaceful nuclear explosives. Much publicized in the 1960s as a way to use nuclear explosions for peaceful purposes, it was endowed with the virtues of not creating radioactive fallout and minimizing long-lasting local radioactive contamination. This project, code-named Plowshare, was initiated by the Lawrence Livermore Laboratory and formalized in 1957 by the A.E.C. It was used by Dr. Teller and others to argue against a treaty for a comprehensive nuclear test ban; the project continued well into the 1970s and involved several experimental underground nuclear explosions. It gradually became evident that the economic advantages of using nuclear explosives were either nonexistent or at best marginal. When the United States lost interest in Plowshare, the Soviet Union began to insist on the great value of such projects. As a result the test ban treaties negotiated (but not ratified) in the mid-1970s included the right to use nuclear explosives for peaceful purposes.

Then last fall, to the considerable surprise of the western world, Secretary General Brezhnev announced that the Soviet Union was willing to forego these projects. At last the road to a comprehensive nuclear test ban seems not to be cluttered by this peripheral issue.

Through Washington's Back Door

In the mid-1960s, the Sentinel Ballistic Missile Defense (ABM) System for American cities was being developed by the U.S. Army. It was to involve, among other components, the short-range ballistic missile called Sprint for nearby defense of cities. These missiles were to destroy the enemy ballistic missile re-entry nosecones at relatively low altitudes near cities without detonating the large incoming warheads and without their own detonation damaging the cities. To achieve this, the Los Alamos weapons laboratory of A.E.C. turned to an "enhanced radiation" design for the Sprint nuclear warhead. This design was tested underground in Nevada in the late 1960s. Later these warheads were manufactured to equip the Sprints.

Several activist groups opposed the Sentinel System on the grounds that it was ineffective, excessively costly, and militarily provocative. The inept responses of the protagonists led to such a public reaction that Project Sentinel was cancelled in 1969.

However, the Nixon administration, without substantially changing the overall design of the system, renamed the project Safeguard and gave it a new task: the defense of the Minuteman ICBM (intercontinental ballistic missile) silos against any hypothetical counterforce attack by the Soviet ballistic missiles. Thus camouflaged, the ABM proj-

ect squeaked through Congress at budget time in 1969-1970, boosted by the administration's argument that it was needed as a "bargaining chip" in the SALT negotiations with the Soviet Union on the control of nuclear strategic forces.

But then came the ABM Treaty, a part of the 1972 SALT I agreements. The ABM Treaty restricted each superpower to no more than two ABM installations. In the United States the construction of one installation near Grand Forks, N.D., went ahead. This installation was declared operational in 1974, but was shortly moth-balled as not cost-effective.

As far as I know, this \$5 billion relic of the Army brass' effort to share in the strategic arms budget and activities remains inactive to this day, as do the several dozen Sprint missiles stored now in some Army ammunition depots.

During the tenure of Secretary of Defense Robert MacNamara, the emphasis in nuclear weapons was on deterrence through the maintenance of capacity for assured retaliatory destruction. The details of battlefield nuclear tactics were therefore of secondary interest; accordingly, low priority was given to the modernization of tactical nuclear weapons. However, as a part of the modernization of mobile short-range surface-to-surface missiles in the mid 1960s, several new nuclear warheads were developed to arm the new Lance missile. The one warhead of this group planned to have enhanced radiation was terminated as not satisfactory to the Army.

Trying to Deter the Pentagon

With the arrivals of Secretary Melvin Laird and then James Schlesinger, who was, judging by his public statements, more interested in problems of fighting nuclear wars than just in deterrence, the attitude toward tactical nuclear warfare changed. The Army requested funds to modernize its tactical nuclear weapons. ERWs were not included because a number of senior army leaders regarded ERWs as ineffective on the battlefield. The reason for this scepticism was the finding based on some animal experiments (and refuting what we in P.S.A.C. were told in 1960) that enemy troops would be nearly instantly incapacitated only within a relatively small area near the explosion. But troops occupying a much larger area further away would still retain their fighting capability for a short time before succumbing to the radiation effects, seriously impairing the battlefield effectiveness of small nuclear warheads.

However, the Army's plans to modernize conventional warheads were rejected by the Joint Congressional Committee, influenced no doubt by the spokesmen of the A.E.C. weapons laboratories who, as usual, were institu-

tionally most eager to push ahead with nuclear weapons technology. Thus in early 1973, Harold Agnew, the Director of the Los Alamos Laboratory, evidently referred to the ERWs in his testimony before the Joint Committee on Atomic Energy, when he stated: "I know we at Los Alamos are working very aggressively trying to influence the Department of Defense to consider these [deleted] . . . weapons which could be decisive on a battlefield, yet would limit collateral damage that is usually associated with nuclear weapons." As a consequence of these kinds of political pressures during the tenure of office by Mr. Schlesinger, the tactical ERWs became a major development project, which however was lost by Los Alamos and granted instead to Livermore.

By now the development of the ERW was a technical success. In 1976 President Ford, already a lame duck, signed an authorization, as required by law, to manufacture and stockpile ERWs for the Army's surface-to-surface ballistic missile Lance and nuclear-armed shells for 8-in artillery guns. This project was highly classified and known to only a few members of Congress.

The money for the production of ERWs was included in the fiscal year 1978 budget proposal and the Energy Research and Development Administration, which took on the duties of the A.E.C., buried this item in its part of the \$10 billion public works section of the President's budget. E.R.D.A. provided no potentially revealing arms control impact statement, although these are required by law for new weapons. Altogether the procedure was, at the least, improper.

Subsequent events are quite involved, and I reconstruct them here partly from numerous articles in the *Washington Post* by Walter Pincus starting on June 6, 1977.

The review of the Ford budget proposals for fiscal year 1978 by the incoming Carter administration in early 1977 resulted in the elimination of \$65 million for the production of non-nuclear Lance warheads. The reason given to Congress was that their use would not be cost-effective: the Lance missiles, which have a range of about 100 kilometers (depending on the weight of the warhead), were too expensive — about \$100,000 each. Another \$43-million line item, this one for nuclear warheads, was left in the budget. It appears that neither President Carter nor Secretary of Defense Brown were informed that a new technology was to be thus introduced into the military arsenal until the following June when the issue, much against the Pentagon's wishes, became public.

Congress Wakes to Struggle for Control

In the beginning of June, 1977, Senator Mark O. Hatfield (D.-Ore.) learned that the budget item for Lance nuclear warheads was actually for building neutron warheads. He

“... it is preposterous to call the neutron bomb humane, as some of its proponents insist. It is no more humane than the fission warheads and, perhaps, is even worse in its similarity to the delayed effects of the poison gases used in World War I...”

may have rediscovered the earlier secret testimony on the Lance warhead before a House appropriations subcommittee by an assistant director of E.R.D.A. in charge of military applications. At any rate, Senator Hatfield offered an amendment to the Pentagon's public works budget bill then before the Senate military appropriations committee. The amendment was to strike from the bill the funds for the production of Lance nuclear warheads. The Chairman of the committee, Senator John Stennis, (D. Miss.) opposed this and the amendment failed on June 22 by a ten-to-ten tie vote.

In the meantime the White House responded to reporters' queries and issued a statement saying that President Carter was not bound by President Ford's action. President Carter would make an independent decision about the production of ERWs when certain military policy reviews were concluded, the statement said. In response to another inquiry, William J. Perry, the Director of Defense Research and Engineering, informed Senator Hatfield of the possibility that the President would not make a decision on the ERW for Lance until the start of the new fiscal year 1978 in October. Still, Mr. Perry urged Congress to appropriate the funds without waiting for this decision.

Toward the end of June, the House voted the funds for the ERWs. And on July 1, the Senate accepted an amendment by Senator Stennis designed to gut that of Mr. Hatfield. Then, on July 13, after a message from President Carter that the provision of funds for the production of the new warheads was in the national interest, the Senate held a day-long and rather bitter debate. At its end, the Senate approved the public works bill, rejected another Hatfield amendment and one introduced by Senator Edward Kennedy (D.-Mass.), which would have allowed either the House or Senate to block any presidential decision to approve construction of neutron warheads. The Senate accepted an amendment by Senator Byrd, however, which gave Congress 45 days to pass a concurrent resolution disapproving the production of these warheads if the decision to go ahead was taken by the President.

As these parliamentary maneuvers were taking place, it was revealed that the money earmarked for Lance warheads would also be used to produce enhanced radiation artillery shells (under test since 1975) for the 8-in guns which are now armed with more conventional nuclear warheads. The ongoing development of ER nuclear projectiles for the 155-mm artillery was also revealed.

Performance on the Battlefield

On August 13, 1977, the U.S. Arms Control and Disarmament Agency (A.C.D.A.) delivered the requested Arms Control Impact Statement for the “W-70 Mod 3 (Lance) Warhead” to Congress. The statement noted that a 1-kt

ERW gives the same expectancy of tank crew incapacitation by radiation exposure as a 10-kt fission warhead. (With both warheads, radiation is the chief anti-tank agent since armored vehicles are highly resistant to blast and thermal effects of nuclear explosions.) The statement noted that collateral damage — damage to the civilian environment of the battlefield — will be only that of a 1-kt weapon, thus substantially less than that of conventional fission warheads. No impact statements for the 8-in and 155-mm artillery projectiles were released by A.C.D.A.

In the fall of 1977, President Carter once again postponed the decision on the production of ERWs.

It has been stated in open literature that the “ordinary” nuclear warheads that now arm the Lance missile have a range in yield from 1 kt to as high as 100 kt; those for the 8-in guns range up to 10 kt. The proposed ERWs for Lance and for the 8-in guns are described as of 1-kt yield, although the impact statement maintains that the Lance warhead has a “selectable yield capability,” and hence its strength may be varied in the field by the crew deploying it. The presumed range is from less to more than 1 kt.

Because the fission “trigger” contributes to the explosion effects, the ERWs are not pure fusion devices. The Lance warhead, for example, releases about 60 per cent fission and 40 per cent fusion energy upon explosion. The handbooks on the effects of nuclear weapons describe the neutron radiation intensity as a function of the distance from the center of a thermonuclear explosion. This information makes it possible to estimate the neutron radiation from the ERWs that lack a uranium blanket.

The calculation leads to the finding that at a range of 900 meters, a 1-kt ERW explosion in the open produces an exposure of 8,000 rads. Soviet tanks supposedly now have a radiation protection factor of 0.5. This means that the tank crews at 900 meters from the explosion would receive a dose in the neighborhood of 4,000 rads.

According to the Pentagon's experiments with rhesus monkeys, this dose is more than enough for “immediate transient incapacitation”; that is, it will induce within five minutes a total inability to perform physically demanding tasks. This is deemed to be an adequate incapacitation on the battlefield. Although the troops would recover partially in about half an hour, their condition would gradually deteriorate, leading to death in two to six days. At about 700 meters the radiation intensity would be double that at 900 meters, and, according to the rhesus monkey tests, that exposure would result in “immediate permanent incapacitation,” the agony, however, lasting one or two days until death.

Some military strategists argue that disciplined personnel, even though exposed to the extent of “immediate

"When delayed deaths . . . are counted in, it ceases to be obvious that the use of ERWs would be substantially less disastrous to the civilian population in western Europe than that of fission warheads."

transient incapacitation," would resume participation in battle after their partial recovery — perhaps even more recklessly than others, because they would know that they are the walking dead. In any case the tank crews and other military personnel exposed to less radiation than that causing "immediate transient incapacitation" would be able to participate in the battle, if temporarily. Thus, an exposure to 650 rads (at about 1,400 meters from the 1-kt ERW explosion in the open or 1,200 meters in a tank) would not impair human functions until an hour or more later. But it most likely results in death a couple of weeks later, after a gradual and painful physical decay.

Radiation and the Civilian Population

Reliable statistical information on the delayed effects of exposure to still lower doses of ionizing radiation is available from observations on the survivors of the Hiroshima and Nagasaki bombings, and on unintended victims of nuclear weapons tests in the Pacific — the aboriginal population of the Marshall Islands and the crew of a Japanese fishing vessel.

At 1.7 km from the 1-kt ERW explosion, the radiation exposure drops to 150 rads. Statistically this exposure results in about a 10-per-cent death rate from radiation sickness within a few months, and also in high incidence of leukemia, and breast, thyroid, lung, and stomach cancers. These may be delayed as much as 20 to 30 years, killing several additional per cent of the exposed individuals. Most male survivors become sterile.

At 2.1-km, the predicted exposure drops to 15 rads. At this level radiation sickness is not experienced after exposure, but some delayed cancers and leukemia are expected in the exposed population.

The genetic effects, that is the harmful gene mutations that may manifest themselves for several generations, also decrease with lessening exposure and increasing distance. At about 2 km, the frequency of mutations in exposed individuals would be double the spontaneous rate.

These estimates of the after-effects of radiation exposures are, however, most likely conservative ones. They have been derived from observations on individuals exposed largely to gamma radiation. ERWs, however, cause damage largely by neutrons. It is well established that high-energy neutrons, per rad of exposure, produce about seven times as much biological damage as that of gamma rays. Thus, the effects described as taking place at 1.7 km distance might actually apply to 2.1 km distance, and so on.

While distance determines the amount of radiation exposure a person will receive in the open, in order to assess the total effects of an explosion one must also consider the areas involved. In the absence of specific information

to the contrary, one must assume a random, that is uniform, distribution of exposed individuals over the explosion's entire range. In doing this, one finds that the immediate area in which tank crews will suffer rapid battle incapacitation is but one-fifth of the total 4-km diameter area of radiation effect. Within this area, the great majority of exposed individuals will suffer radiation illness; and a large fraction of the people will die either from that or from delayed cancers.

Considering these facts, it is preposterous to call the neutron bomb humane, as some of its proponents insist. It is no more humane than the fission warheads and, perhaps, is even worse in its similarity to the delayed effects of the poison gases used in World War I which were outlawed by the Geneva Convention of 1925.

The Battlefield Use is Challenged

There is little doubt that collateral damage to civilian structures and persistent radioactive contamination by fallout would be reduced if the present higher-yield fission tactical warheads were to be replaced by the ERWs. Whether the same is true about civilian casualties, however, is doubtful.

The main purpose of ERWs is to restrain a major blitzkrieg breakthrough involving very many armored vehicles, a tactic calling for large numbers of ERWs — indeed for veritable neutron bomb barrages.

But Soviet war tactics call for tanks in the nuclear warfare environment to be widely spaced. Also, if N.A.T.O. forces were to deploy ERWs as their prime anti-tank weapon, the Soviets would wisely provide added radiation protection for their tank crews. A 10-cm layer of a suitable hydrogenous material, say water in plastic bags over the crew compartment, followed by a thin sheet of cadmium metal, would reduce neutron radiation intensity by about a factor of five. Thus the effective range of an ERW explosion would be reduced drastically. Furthermore, since exposure to neutron radiation would leave many of the armored vehicles in useable condition, and the battlefield not poisoned by fallout, the attacker could be prepared to use replacement crews which would return the armored vehicles to battle in short order.

Estimating the civilian effects of these ERW barrages is a depressing task. Perhaps the number of *prompt* deaths of bystander civilians would be lower, but when delayed deaths from radiation sickness, leukemia, cancer, etc., are counted in, it ceases to be obvious that the use of ERWs will be substantially less disastrous to the civilian population in western Europe than that of fission warheads.

According to the testimony of the N.A.T.O. Commander, General A. M. Haig, Jr., before the Senate Armed Services Committee this March 1, N.A.T.O.'s military

leaders mostly favor deployment of the ERWs. This, of course, is merely consistent with their continuing insistence on the recourse to nuclear weapons in case of an attack by Warsaw Pact forces.

The A.C.D.A. impact statement takes a nearly neutral position: "It can be argued that the improved ERW may make initial use of nuclear weapons in battle seem more credible, which might enhance deterrence. However, by the same token, it can be argued that it increases the likelihood that nuclear weapons would actually be used in combat." The latter argument has been advanced by several thoughtful opponents of the neutron bomb, and is one which, I, too, weigh heavily. In the eyes of their protagonists, the deployment of ERWs, would enhance the credibility of the initial use of nuclear weapons. In reality it is quite likely to lower the nuclear threshold if N.A.T.O. forces are attacked, without correspondingly increasing the deterrence of attack, which is largely based on the fear of escalation of nuclear combat to an all-out warfare. And, as the impact statement notes, "The escalating potential is the same for this weapon as for any other nuclear weapon." This assessment is diametrically opposite to the assertion of some American military writers that the use of ERWs would avoid nuclear escalation.

The American opponents of the neutron bomb — they include all those who seek a reduction of tensions by arms control agreements — have advanced additional arguments against the deployment of ERWs. Soviet military doctrine calls for immediate massive response with nuclear weapons to any first nuclear use by the N.A.T.O. forces; and Soviet tactical warheads are estimated to be large and "dirty." This, of course, nullifies the argument that the use of ERWs would reduce collateral damage.

N.A.T.O. Debates the Shift to Nuclear Deterrents

In last fall's postponement of the decision on whether to produce ERWs, President Carter was undoubtedly aware of the intense public debate in Europe about the acceptability of the battlefield use of the ERW. Therefore he stated that his decision about the production of ERWs would be responsive to the wishes of our N.A.T.O. allies to deploy them in Europe.

In recent years, American armchair and ambulatory strategists have stressed that the restriction of tactical nuclear weapons to mini-nukes (especially to ERWs) would create a "fire-break" against any escalation to a strategic nuclear force for a tactical nuclear war in Europe. Such decoupling of tactical and strategic nuclear warfares, which, of course, would protect American homeland, has been for years a favorite subject of American writers who favor deterrence by the use of tactical nuclear weapons.

Not surprisingly, this thesis finds little support in western Europe, especially in the Federal Republic of Germany (F.R.G.), the prime battleground in the event of an attack by Warsaw Pact forces. Thus a 1972 report of the West German Defense Ministry on N.A.T.O. states, "Only by this inseparable connection between tactical and strategic deterrence is N.A.T.O. capable of equating the conventional [military] superiority of the Warsaw Pact." And Helmut Schmidt, then the Defense Minister of the F.R.G., objected to the exclusively tactical use of nuclear warheads as "unimaginably cruel to the Europeans." The Chairman of the Armed Services Committee of the Bundestag, M. Woerner, also endorsed the need for coupling the tactical and strategic nuclear forces. He wrote in 1977 that, "... the territory of the U.S.S.R. cannot be allowed, in theory or in practice, to become a sanctuary in the nuclear phase of a conflict in Europe."

From the moment that the neutron bomb issue surfaced in Washington, the European and particularly the West German media, the press, and the scholars and politicians have devoted much space and time to it. The conservative papers generally endorse the deployment of ERWs in West Germany, but the moderate and liberal publications oppose it.

On the political level the German public debate was triggered by an article by Egon Bahr, the Executive Secretary of the Social Democratic Party (S.P.D.) and an influential member in the government of former Chancellor Brandt. In it, he unequivocally condemned the neutron bomb on both moral and ethical grounds as a "symbol of mental perversion." Most of the other spokesmen of the S.P.D. also opposed the ERWs because they would lower the nuclear threshold and encourage the initiation of a nuclear battlefield without assuring escalation to the strategic levels. A few, such as K. Ahlers, tentatively endorsed ERWs last summer, although more recently he seems to have changed his view.

At the German Socialist party convention last November, a compromise resolution was endorsed which urged upon the Schmidt government such policies which would make unnecessary the ERW's deployment in West German territory. The government of Chancellor Schmidt has so far refrained from publicly committing itself, although the Defense and Foreign Ministers have made statements which seem to be in favor of the ERW deployment.

Among the political-strategic think-tanks of German academia only one, which includes retired General Kielmansegg, endorsed the deployment of ERWs. The others, including such distinguished scholars as C. F. Weizsaeker, have opposed it on numerous occasions. Several of the senior retired German military, including such high-

Scenario for a Neutron Bomb

Imagine a force of Soviet tanks, each manned by three or four soldiers, concentrated in a square of two kilometers area at the edge of a German village. A massive, near-invincible force.

The N.A.T.O. commander responsible for the battle sector orders detonation of a 1-kiloton enhanced radiation warhead (neutron bomb) at a height of 130 to 200 meters above the enemy tanks, at the edge of the village. What will happen?

Farooq Hussain, a Research Student in the Department of War Studies at King's College, London, answers in *New Scientist* (February 23, 1978):

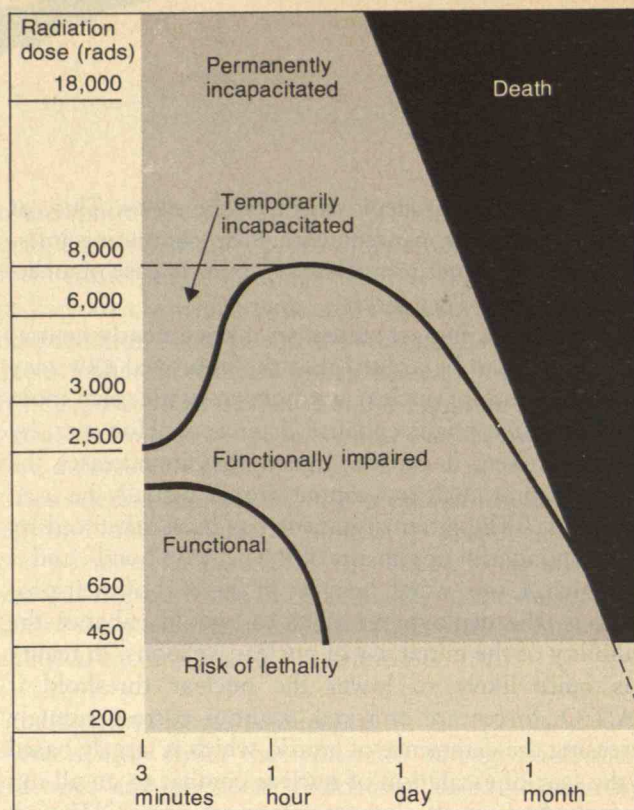
The bomb will destroy only a few buildings in the town — only those near the point directly beneath the detonation.

But every Soviet soldier in every tank receives a lethal dose of radiation, and all almost immediately experience symptoms of radiation sickness. Perhaps 300 soldiers are within 1 kilometer of the blast; they are quickly incapacitated and all will be dead within two days. The 500 soldiers between 1 and 2 kilometers from the center will survive for a week or more, and within an hour after irradiation many will regain apparent health and be able to resume fighting. Perhaps 200 more soldiers at locations 2 to 2.5 kilometers from "ground zero" will live for as long as a month.

As Dr. Hussain's chart (right) shows, most of these victims, though eventually doomed to death, would not be fully disabled for several hours or even days after irradiation. How soldiers might respond to the physical and emotional pressures of such a situation is not easy to imagine.

Here is how Dr. Hussain summarizes present knowledge of the effects of exposure to high levels of radiation:

"Sickness from exposure to high levels of radiation is preceded by an initial period similar to travel sickness. Dosages of 8,000 rads and over affect the central nervous system. Such exposure causes collapse within minutes and death within 48 hours. A dose of 3,000 rads results in gastrointestinal syndrome, with vomiting, diarrhoea, high fever, and



eventually coma; death occurs within 14 days. Exposures over 450 rads cause bleeding under the skin and from the gums; death follows within three weeks of irradiation. Damage to bone marrow occurs around the 100 rad level; death need not result, but prolonged sickness is inevitable." — J.M.

ranking generals as Baudissin, Steinhoff, and Heusinger, are against the deployment of ERWS because they believe the battlefield use of nuclear weapons will lead to unacceptable collateral damage in Germany.

In this extensive debate, which shows no signs of termination, other objections to ERWS have also been raised. Their deployment in large numbers near the forward N.A.T.O. defense lines may result in a loss of control by Washington over the initiation of nuclear warfare. Just such concern induced the American withdrawal from Europe a decade ago of the original mini-nuke, the Davy Crockett anti-tank infantry weapon.

It was also argued that extensive deployment of ERWS may induce a pre-emptive nuclear strike by the Soviet Union. This would start nuclear warfare on terms highly unfavorable to N.A.T.O. forces.

In the rest of western Europe, the neutron bomb has been less than a burning issue. The governments of N.A.T.O. countries which were queried on their position

regarding the deployment of ERWS by Congressman Christopher Dodd last September had given him "ambivalent responses." The British, for instance, produced a nice piece of officialese double-talk by assuring Mr. Dodd that they are "satisfied with the consultations that have taken place so far." Quite recently, President Brezhnev dispatched letters to the heads of governments of N.A.T.O. countries warning them against the deployment of ERWS. This intervention was preceded and followed by other forms of protest by the Soviet Union against the neutron bomb. These rather unusual personal messages from President Brezhnev were interpreted as a threat; it produced, of course, a rather negative reaction in the West and may work toward the deployment of the ERWS.

The non-government reaction in the West to the ERWS has been less extensive than in F.R.G. The writers associated with peace-oriented organizations, such as the Stockholm International Peace Research Institute

(S.I.P.R.I.) and several unaffiliated academics concerned with disarmament, strongly oppose the neutron bomb on grounds which have already been discussed here. They also are generally opposed to the introduction of ever new technologies into the military arsenals — a strategy which is now properly recognized as a major block to the cessation of the arms race.

Relatively few voices have been raised in favor of ERWs; those are largely from the conservative and the militarily oriented wings of public opinion makers.

In late February, the government of F.R.G. called for extensive arms control negotiations with the Soviet Union before any deployment of the neutron warheads takes place in Europe. Then, in early March, the Dutch Parliament voted to oppose the deployment of ERWs and instructed the Dutch government to inform its N.A.T.O. allies of this vote.

Summing up the political situation, it would appear that if the allied governments, especially that of F.R.G., recommend that President Carter approve the production and deployment of ERWs, they will do so against a significant, perhaps even very strong domestic opposition. But if the ERWs are not deployed, would that signify an inability of the N.A.T.O. alliance to counter the Warsaw Pact's military threat?

American hardliners regard this threat as massive and imminent. Frank Barnett, the director of the National Strategy Information Center wrote: "[The United States] . . . is about where Britain was in 1938, with the shadow of Hitler's Germany darkening all of Europe." The American military, including General Haig, paints a grim picture, some of which perhaps can be discounted as a necessary conditioning of Congress before military budget hearings. Indeed, the annual report of the Secretary of Defense Harold Brown, while recognizing the possibility of future threat, clearly does not regard it as imminent. Finally, Congressman Les Aspin, a highly qualified analyst of military problems, deflated Mr. Barnett on the basis of numerical data provided him by the Pentagon, which indicated that during the period of 1972 to 1976 the Soviet production of tanks and tactical aircraft (both important indicators) exceeded that required merely to maintain level inventory by only a few per cent a year — a tiny fraction of the rate of buildup of forces by Nazi Germany in 1938.

A Real Alternative

And although the numerical tank superiority of the Warsaw Pact forces is unquestionable, the severity of the threat this poses is disputable. Most important in this regard is the record of the 1973 Arab-Israeli war, which showed that even the modern tanks are very vulnerable to the high-technology "precision guided" munitions which were then extensively employed for the first time on the battlefield. These munitions find their origins in such early devices as the French wire-guided anti-tank rocket of the 1950s and the "smart" guided bombs of the late phase of the American war in Vietnam.

The demonstration of the effectiveness of the "precision guided" munitions against massed tanks in the Mid-

dle East has stimulated intense development efforts. According to the Annual Report for fiscal year 1979 of the Secretary of Defense, American forces in Europe now deploy weapon systems code-named Tow, Dragon, and Cobra/Tow. It has been said of these systems that "what can be seen will be hit, and what will be hit will be destroyed." The "seeing" is being done with the aid of infrared, lasers, radar, and so forth. Another important anti-tank role is attributed to a *guided* artillery shell for the 155-mm gun, code-named Copperhead. The F.R.G. has deployed an anti-tank device called Milan. Our European allies have several other advanced battlefield anti-tank weapons undergoing final evaluation.

Such developments have led the Under Secretary of Defense for Research and Engineering, W. J. Perry, to say, "We can greatly enhance our ability to deter war without having to compete tank for tank, missile for missile with the Soviet Union."

The "precision guided" munitions are extremely inexpensive when compared to battlefield nuclear weapons. However, to be decisive they have to be deployed in much larger numbers than the ERWs. Therefore, their choice as the main anti-tank weapon will call for greater combat manpower, and these troops will probably have to be more intensively trained. These are serious disadvantages, but the use of such weapons in repelling a tank attack would require no authorization from some remote headquarters, which would have to work its way up and down many military and civilian echelons and hence could mean a substantial and possibly an irreparable delay.

If main reliance is placed on battlefield nuclear weapons, the concern about the possibility of an irreparable delay will certainly speed up the authorization of their use, and hence will lower the threshold to nuclear warfare. What will follow will be massive civilian casualties and other collateral damage in the environs of the battlefields, and even these will be but a prelude to the nuclear devastation of Europe, and general nuclear war.

These being the alternatives, it is impossible to escape the conclusion that N.A.T.O. military efforts should emphasize various sophisticated "precision guided" munitions, and that ERWs, as well as older battlefield nuclear weapons, should be put in mothballs.

Therefore I strongly support the decision of President Carter on April 7 not to produce the ERWs, although his making them into a sort of a "bargaining chip" with the Soviet Union is not likely to succeed, having been made public, and will probably cause him much domestic difficulty.

George B. Kistiakowsky, Professor of Chemistry, Emeritus, at Harvard University, has made many important contributions to American science. He was a member of the national Academy of Sciences Committee on Atomic Energy in 1941, and Chief of the Explosives Division of the Los Alamos Laboratory from 1944 to 1946. He was Special Assistant to the President for Science and Technology under President Eisenhower; he retained membership in the President's Science Advisory Committee from 1957 to 1964. From 1962 until 1969 he was a member of the Advisory Board to the U.S. Arms Control and Disarmament Agency. The author is grateful to Dr. Hans Guenter Brauch for putting at his disposal much of the background material referred to in this article.

The Dynamics of International Technology Flows

Denis Goulet
Overseas Development Council

Technology never exists in a social vacuum: it is embodied in products, processes, and people. By the same token, technology does not "transfer," or circulate, in a social void; it circulates throughout diverse institutional channels and mechanisms. Thus social values cannot be separated either from technology itself, or from its mode of transfer. When these values, which are usually determined by the "parent" culture, conflict with those of developing countries, the technology transferred can deter — rather than promote — those countries' social objectives.

The channels of technology circulation are diverse: transnational corporations (TNCs), consultant firms, think tanks, foundations, professional associations, national academies of science, universities, labor unions, voluntary agencies, individuals, national governments, and international agencies. The amount of influence wielded by these diverse agents of technological commerce varies, as do the time and money they devote to the task.

The most significant sources of technology transfer are consultant firms and the transnational corporations for manufacturing, extraction, and service. TNCs disseminate product and process technologies. But "decisional technologies" exist as well; these comprise the know-how required to diagnose complex problems and formulate solutions. Decisional technologies are vital. As Argentine physicist Jorge Sabato puts it: "The ability to conduct a feasibility study with its own means is the touchstone revealing when a country has conquered technological autonomy."

The role of consulting firms is no less important than that of manufacturing or mining firms. Indeed, the competitive edge of corporate industries is largely a function of their link to consultants in such fields as finance, engineering, design, and marketing. Since their grip on technology is less tangible than that of manufacturing or extractive firms, however, I shall first examine how firms of this sort engage in technology "transfers."

Transnational Transfer

Manufacturing, extraction, and service firms employ numerous means to transfer technology: direct investment; exports of machinery, equipment and products; industrial and trade fairs; licensing contracts; training arrangements; supervision or quality control at production sites or at home plants; and technological workshops.

Recent debates over the impact of TNCs on development have exposed the benefits and disadvantages attendant upon technology transfers. For years, governments, national firms, and scientists in developing countries simply assumed that technology was transferred successfully via the mechanisms cited above. They are now crit-

ically aware of the difference between genuine assimilation with mastery, control, and improved ability to gain future autonomy, and transfer of technology. Armed with this knowledge, governments of developing countries are pressing for new contractual terms in technology transfers. Under the sting of newly honed criticism, TNCs are discovering that they can no longer operate as before. The more enlightened firms are preparing to renegotiate terms on the basis of "mutual concessions" of undetermined breadth. For most TNCs, however, change is slow: their own interests already are served well by the conventional modes of "technology transfer." A brief description of these modes explains why companies favor them.

□ *Direct investment* is easy to manage. Once a TNC learns how to master international currency transactions, recruiting personnel from various cultures, and the logistics of transnational transportation, the procedures of direct investment are congenial to the corporation's basic values. Negotiations with host governments are no doubt troublesome, as is red-tape for import licenses and profit remittances. But these procedures are easily accommodated and pose no threat to the corporation's interests or work arrangements.

In large corporations the conduct of technology transfer overseas differs little from the domestic flow of technological findings from research and development laboratories to the home plants. Engineers, chemists, and other specialists routinely "plug in" the results of research and development to ongoing firm operations, giving little thought to such notions as competitive edge, market advantage, cost efficiency, and overall coordination of procedures. These priorities are left to managers. When these technicians move to an overseas affiliate, they operate in the same way.

Nevertheless, most governments of developing countries are far more sensitive than "developed" home governments to such issues as higher employment rates, national control over technology, and brain drain. And for most TNCs, these are disquieting but quite secondary considerations. When these concerns create serious "image" problems, however, or when host governments press to change the ground rules of negotiations, TNCs are forced to react. They must decide whether they gain or lose more by making concessions. Concessions are usually presented to the public as evidence of the cooperative spirit of the enterprise. Experienced government officials in developing countries understand this strategy; once they obtain substantive concessions, they are prepared — like all experienced negotiators — to "let the other side save face."

Pressured by new government demands, many TNCs

MIT '78

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David S. Saxon, '41, distinguished first as a physicist, now finds himself a leading advocate of minority rights **A5**

Sensing the growing role of government in their future professions, M.I.T. students take time out to learn about budgets and policy **A6**

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How to Make New England's Strongest Fraternities Even Stronger Tomorrow

The M.I.T. fraternity system — "the largest and strongest in New England and one of the best in the country" — has three major challenges, says Steven J. Piet, '78, Chairman of the Interfraternity Conference:

- ☐ To reassert the leadership of the fraternities in student affairs throughout the campus.
- ☐ To plan more effectively for future needs and take a more active role in meeting them.
- ☐ To cooperate among themselves more effectively through the Interfraternity Conference.

Mr. Piet's remarks came at the end of a one-day student-alumni conference on fraternity management sponsored jointly by the I.F.C. and the Alumni Interfraternity Conference. There were student-alumni seminars on such topics as financial management, rushing and pledge education, and alumni relations.

And some nostalgia, too: James R. Killian, Jr., '26, Honorary Chairman of the Corporation, assured the students that he still values the "sense of companionship" which he associates with his fraternity as an undergraduate. "I always find it inspiring," he said, "to return and hear fraternity members singing their songs with the same lusty vigor that I remember from my undergraduate days."

Reasserting the Fraternities' Leadership

Fifteen and 20 years ago, said Mr. Piet, there were "organized, responsible student groups and individuals" with a leadership role on the campus. Students, he recalled, helped start the Independent Activities Period, freshman pass/fail, and other academic reforms. Student activities were aggressive and cohesive and commanded the interest of many undergraduates.



The Boston Globe

On the opposite page, James L. Bidigare, Jr., '78, who's a member of Sigma Chi, writes that "there is strong evidence of renewed spirit and new energy" in M.I.T. fraternities. The pictures on these pages support the argument. (Photos: Gordon R. Haff, '79, from *The Tech*; John W. Lepingwell, '80, and William D. Hofmann, '80, from *Technique*; and Phi Kappa Sigma)



Today it's different, said Mr. Piet: "Beyond the fraternities, current student government on campus is essentially worthless. Student leaders are either not functioning or not serving the undergraduate community."

What's wrong — the difference between yesterday's successful and today's moribund student government?

"One reason campus organs used to work," said Mr. Piet, "was the involvement and leadership of fraternity men. . . . Consistently over three-quarters of campus leaders were fraternity people. When they withdrew from the scene, matters deteriorated. Various social activities vanished; finding good intramural organizers became more difficult; lines of constructive communication to the administration and faculty rotted.

"Many of us profess mottoes concerning service to others. . . . Surely we who work through the intricacies of house finances, survive being stewards, perpetrate the wonders of rush week, and engineer amazing feats in our houses can handle such matters as improving campus media, improving athletic facilities and intramural organization, telling the administration and faculty our views, and continuing to improve social life.

"It's up to us," said Mr. Piet.

"The Future Will Not Take Care of Itself"

Fraternities need to devote more time to long-range planning, so that financing for new plumbing or a new roof won't be an insurmountable problem.

For such expenditures fraternities now rely on the Independent Residence Development Fund, but "that Fund is not limitless," Mr. Piet warned. "In fact," he said, "estimates are that the I.R.D.F. and other low-cost financing will fall short of our needs by several millions of dollars over the next decade or two. . . . The future will not necessarily take care of itself."

The I.F.C. demonstrates every fall the value of cooperation during Rush Week. But that's only the tip of the iceberg, Mr. Piet said, of the advantages to the fraternities of a stronger I.F.C. "Combining experience and knowledge is easier than having to individually re-invent the wheel." — J.M.



Fraternities: Stronger Now — and Poised For New Campus Leadership

by Jim Bidigare, '78

There is strong evidence of renewed spirit and new energy within the fraternity system at M.I.T.

Like most aspects of education, fraternities have been going through changes sparked by the student activism of a decade ago.

The turmoil on campus in the late 1960s brought question to the educational, social and moral structures of the times. Tradition no longer carried on without debate.

Fraternities were included in this questioning. They too experienced dissent, and then apathy — putting them in probably their weakest position since World War II.

The M.I.T. fraternity system is fortunate in that, while it also experienced the upheaval of the times, none of its chapters folded. Its greater strength and better organization kept it going, while other schools lost large parts of their fraternity systems. Here, fraternity members questioned the basic structure of their houses, asking if there might not be more rewarding and effective paths to the high ideals around which their groups had formed.

The institutional conservatism of fraternities did not respond to this introspection. Pressure built, and many houses saw themselves divided — brother against brother. Commitment was made neither to the roots of tradition nor to the new ground broken by activism. Affiliation with nationals — another tie with the past — was seriously questioned.

Better Ways to Brotherhood

Then the fraternities found themselves at one of the weakest moments in their history. Some houses chose to cut their ties with tradition as represented by the nationals.

Some houses, rather than take this step, chose to rebuild. A few houses started with completely new groups of members, hoping to redefine the purpose of their fraternities.

Students' goals today have taken on a new purpose. While a few years ago pursuit of higher education was seen mainly as a period of introspection and individual growth, it has now become the means to an end — a career. With goals set for school, students have also started to seek goals for their fraternities, seeking something beyond a static cooperative group.

"Today, the M.I.T. fraternities are the strongest they've been in a decade." This statement, made at the 1978 I.F.C./A.I.F.C. Symposium by the I.F.C. Chairman, Steve Piet, '78 (see left), confirms that fraternities are on the move. After passing through the difficult times of the 1960s, they are meeting the challenge of change. The symposium itself, where some 250 fraternity members and alumni met to exchange ideas, could

not have happened three years ago.

Fraternity members are undertaking to discover better ways to achieve brotherhood — ways that respond to the student and his environment today. Few aspects of fraternal living have been adopted or readopted without close scrutiny of their value towards the higher purposes for which fraternities were founded. Tradition is now valued only if it helps achieve those high ideals in a way that is acceptable to today's student.

Pledge programs, the most vivid example of the educational nature of fraternities, are taking on new value. The education of new members, left unaddressed by many houses in the past few years, is again being given structure and direction — this time in a much more positive sense. Pledge programs aim at developing positive commitment from their new members, not at forcing unity through group antagonism.

Houses after the 1960s did not seek new ideas outside themselves. The prevailing attitude was "I'll do my own thing, and the hell with everyone else." Only in the past few years have houses started to interact with each other. With this interaction comes the realization that houses have common problems; some have dealt with these problems innovatively and intelligently.

As houses share ideas, they grow stronger. By comparison, they can see their own strengths and weaknesses. The growing awareness of the value of this interaction is evidenced by the strength of the Interfraternity Conference, which is the organizational expression of the need and desire of individual houses to work together for the common good.

Are fraternities satisfied that they are stronger than they've been in ten years? Happy, yes, but not satisfied. This valuable attitude will keep the fraternities growing stronger and keep them responsive to the needs of today. They see the good, and are not satisfied; they see the bad, and are not disillusioned. Rather, they strive to use the good to remedy the bad.

James L. Bidigare, Jr. '78, will receive M.I.T.'s Bachelor of Architecture degree next month and then join an architectural office — either in Boston or in his native Detroit. Mr. Bidigare was Secretary of the Interfraternity Conference in 1975-76; the following year, as I.F.C.'s Community Relations Chairman, he organized a fraternity clean-up drive which has since become a spring tradition in the Back Bay. This year he's Captain of the varsity lightweight crew, and in mid-April he won a five-year term as President of the Class of 1978.



ALUMNI TRAVEL PROGRAM 1978-79

This special travel program, to some of the most interesting areas in the world, has been especially designed for alumni of Harvard, Yale, Princeton, M.I.T., Cornell, Dartmouth, Univ. of Pennsylvania and certain other distinguished universities and for members of their families. It is consciously planned for persons who normally prefer to travel independently, and covers lands and regions where such persons will find it advantageous to travel with a group.

The itineraries are designed for the intelligent traveler, and offer an in-depth view of historic places, ancient civilizations, archeological sites and artistic treasures, as well as interesting and far-flung cultures of the present day and spectacular scenery from virtually the four corners of the globe. The programs are, however, also planned to incorporate generous amounts of leisure time and to avoid unnecessary regimentation so as to preserve as much as possible the freedom of individual travel, while utilizing the savings and the practical convenience which group travel can offer.

Considerable savings have been obtained by using special reduced fares offered by the world's leading scheduled airlines, fares which are generally available only to groups or in conjunction with a qualified tour and which offer savings of as much as \$500 and more over normal air fares. In addition, special group rates have been obtained from hotels and sightseeing companies. By combining these savings with a careful selection of the finest available hotels and facilities, it is possible to offer travel arrangements of the highest standard at moderate and economical cost.

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MEDITERRANEAN ODYSSEY — 22 Days: An adventure into realms of antiquity in the western Mediterranean, with the ruins of Carthage and the Roman cities of Africa in what is now Tunisia, the splendid Greek temples of Sicily (including the famed "Valley of the Temples" at Agrigento and the ruins of Syracuse, the city of Archimedes), the remarkable Norman churches of Palermo, dating from the age of William the Conqueror, and the fortress cities of the Crusader Knights of St. John on the island of Malta. Departures March through October.

VALLEY OF THE NILE — 17 Days: A detailed view of one of the greatest civilizations the world has ever known, the civilization of ancient Egypt along the valley of the Nile. The itinerary includes Cairo, the pyramids of Giza, Sakkara, Dashur and Meidum, Memphis, Abydos, Dendera, the great temples and monuments of Luxor, including the Valley of the Kings and the tomb of Tutankhamun, and a cruise on the Nile of Upper Egypt to visit Esna, Edfu, Kom Ombo and Aswan, as well as the great monumental temples of Abu Simbel near the border of the Sudan. Departures January through December.

THE ORIENT — 29 Days: A magnificent survey of the Orient, including the exotic temples and palaces of Bangkok and the ruins of ancient Ayudhya, the great metropolis of Singapore, the enchanted island of Bali with its unique artistic heritage, the famed port of Hong Kong on the



border of Red China, and a comprehensive visit to Japan which places special emphasis on the cultural treasures and the tranquil beauty of classical Japan at the historic city of Kyoto and at Nara, Uji, Kamakura and Nikko, as well as the mountain scenery of the Fuji-Hakone National Park and the modern capital at Tokyo. Optional visits are available to the ancient temples of central Java and the art treasures of the National Palace Museum in Taiwan. Departures March through November.

BEYOND THE JAVA SEA — 32 Days: A remarkable journey through the tropics of the Far East, from the port of Manila in the Philippines to the tea plantations and ancient civilizations of Ceylon, the Malay Peninsula, the Batak tribes of Sumatra, the ancient temple ruins of Java, the fabled island of Bali, headhunter villages in the jungle of Borneo, and the unforgettable beauty of the lights of Hong Kong. Departures January through November.

MOGHUL ADVENTURE — 30 Days: The great historic and cultural heritage of India, combined with the splendor of ancient Persia and a journey into the high Himalayas in the remote mountain kingdom of Nepal: imposing Moghul forts, ancient temples, lavish palaces, the teeming banks of the Ganges, snow-capped mountains, picturesque cities and villages, and the Taj Mahal, culminating with the famous mosques of Isfahan and the 5th century B.C. palace of Darius and Xerxes at Persepolis. Departures January through November.

SOUTH AMERICA — 28 Days: An unusually comprehensive journey through the vast continent of South America, from the Inca ruins and colonial heritage of the western coast, amid the towering snow-capped Andes, to the great Iguassu Falls and the South Atlantic beaches of Brazil. The itinerary includes the colonial cities of Bogota, Quito and Lima, the great Inca centers of Cuzco and Machu Picchu, La Paz and Lake Titicaca, the magnificent Argentine Lake District at Bariloche, Buenos Aires, the Iguassu Falls, Sao Paulo, Brasilia and Rio de Janeiro. Departures January through November.

THE SOUTH PACIFIC — 28 Days: An exceptional tour of Australia and New Zealand, with Maori villages, boiling geysers, fiords and snow-capped mountains, ski plane flights, jet boat rides, sheep ranches, penguins, the real Australian "Outback," historic convict settlements, and the Great Barrier Reef. Visiting Auckland, the "Glowworm Grotto" at Waitomo, Rotorua, the Southern Alps at Mt. Cook, Queenstown, Te Anau, Milford Sound and Christchurch in New Zealand, and Canberra, Tasmania, Melbourne, Alice Springs, Cairns and Sydney in Australia. Optional extensions available to Fiji and Tahiti. Departures January through November.

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Prices range from \$2,295 to \$3,575 from U.S. points of departure. Fully descriptive brochures are available on each tour, setting forth the itinerary in detail with departure dates, relevant costs, hotels used, and other information. For full details contact:

ALUMNI FLIGHTS ABROAD

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"No ordinary university president" is how Howard W. Johnson (right), Chairman of the M.I.T. Corporation, described David S. Saxon, '41 (left), President of the University of California, when presenting him to his colleagues on the M.I.T. Corporation on March 3. Whatever the decision by the Supreme Court on the "reverse

discrimination" case brought by Allan Bakke against the University of California, Dr. Saxon said at the Corporation Luncheon that day, "the problem of thwarted opportunities for minorities in the U.S. will not go away." Such an assumption would be "the greatest danger of an adverse ruling," Dr. Saxon declared.



Physicist Saxon — "No Ordinary President" — as an Outspoken Advocate of Minorities

When Allan Bakke charged the University of California with discrimination in handling his application to its Medical School because of preferential standards for minorities, the University's President David S. Saxon, '41, was catapulted into an arena very different from the physics laboratories in which he studied at M.I.T. and earlier had taught at the University of California in Los Angeles.

But President Saxon responded without hesitation, leading the University's defense as Mr. Bakke's case reached the Supreme Court last fall and now doing all he can to impress the nation of the continuing need — whatever the outcome of Mr. Bakke's complaint — to end the frustrations of minorities who have long been denied major opportunities in American life.

"To be rich, to be white, to be male, has cleared the way," he told his colleagues on the M.I.T. Corporation at a luncheon on March 3. "To be poor, to be distant from educational institutions, to be a woman, to be a member of a racial minority, has blocked the way — or at best has made it more difficult of passage."

Reaching Out to Everyone, Everywhere

Nothing so superficial as special programs in colleges and universities will resolve the problem, Dr. Saxon said. The effort must reach into all aspects of American life and all levels of schooling; as examples, he described two such broad initiatives now underway at the University of California (see right).

Dr. Saxon admitted that higher education alone cannot solve the problem of equal access to education for all young Americans, regardless of their sex, race, or cultural background. But, he added, "neither can we shift the major responsibility to the elementary or secondary school or to the minority communities or to housing patterns or employment policies or somewhere else. So much needs to be done that there is a role and an obligation for everyone. . . .

"People who hope that this is a limited or short-term problem that will go away are deluding themselves, as the demographic data prove," warned Dr. Saxon. He pointed out that proportions of minorities are continuing to climb in major metropolitan areas such as Boston, New York, and Chicago, and that a new study by California's Lieutenant Governor shows that by 1990 California may become the nation's first Third World state, the first state in which ethnic minorities comprise the majority of the population.

"Our society is face-to-face with two choices," Saxon stated. "Either we must admit that the American dream of equality is only a dream, or we must take the necessary steps to make it a reality."

Spreading the Word on Minority Opportunities

Two examples of the broad initiatives he believes are needed to dispel the myths that perpetuate discrimination in the U.S. were described by David S. Saxon, '41, President of the University of California, at M.I.T. on March 3 (see left):

□ A \$1 million "Partnership Program" now sends University of California people — students, faculty, and staff — into 150 California junior high schools to talk with students, teachers, and counselors about college opportunities and the importance of early preparation. Parents are encouraged to become involved in motivating their children to go on to college. It's probably the largest program at this level in the nation, Dr. Saxon said, "and we are so strongly convinced of its potential" that the University is asking for money to extend it to 100 more schools starting next fall.

□ Among several "outreach" programs for high school students, Dr. Saxon described in detail the University's MESA (Mathematics, Engineering, and Science Achievement) plan. Ninth-grade students apply to this program on their own initiative or because of a teacher's encouragement. They agree to study four years of mathematics and English and at least three years of laboratory science. They receive intensive counseling, tutoring, field trips, lectures, workshops, and relevant summer jobs during their four years of high school. Some 180 students from MESA's early years have now gone on to college, two-thirds of them to technical majors. MESA currently involves 350 students, and will be expanded over the next five years to involve 3,000 students in California.

Students View Government Policy-Making in Action: "It May Not be Rational, But it Works . . ."

It was an opportunity for 12 students to spend three days in Washington, D.C., to see government policy-making in action. Patricia Joffee, administrator of M.I.T.'s Public Policy Program (see right), arranged the trip and was assisted by alumni in Washington who are involved in government.

James Snyder, '80, was one of the group who met with Margaret Power, Ph.D. '74, Legislative Assistant to Senator Edward Brooke, and with alumni in different offices. He came away, he says, with a view of how important the budget is — of who really makes the decisions. (He was surprised; he shared the idea that budgets are dry and boring). He saw that many staff members actually do the work, while one person's name goes on it; how difficult it is to make decisions based on policy analysis. Yet things get done, if not so quickly as desired, he thinks.

"I got a sense of how interdependent everyone is, that there is a process of gathering and compiling things, from inside and outside each agency — and it works," he says. "The first reaction of students to government is to be disillusioned; government is not at all rational. But I didn't get cynical, despite all the undercurrents."

Mr. Snyder wants to be a journalist — so it was of special interest to him to sit in on a story conference at the *Washington Post*. His description, told with a mixture of enthusiasm and admiration: "Heads of all the departments crowd together in a little room to go over their material — stages of progress, space budget (columns) for each story, which topics are on a national level, which to hold . . . They jockeyed things around for 20 minutes — and in that time discussed 20 stories. In the evening they decide what will go on the front page; what the headline will be."

Ken Lesley, '78, studies mechanical engineering but was interested in political science, so he went to Washington to see what happens first hand. "Not very efficient," was his impression, "but it seems to work out well in the long run." He says it was quite an experience to see the difficulty of taking a long-range view.

"One of the purposes of the trip," explains Ms. Joffee, was to "dispell myths that only hacks work in government. There are a great number of intelligent, competent people involved. My agenda was to introduce students to people who are doing a good job — not cynics, but realists. It's too easy to get cynical. Government has small resources to solve big problems." "The people in government have to be dedicated," interjected Mr. Snyder; "the pay is not good enough." — M.L.

Public Policy Program: Political Aspects — and Opportunities — in Technical Fields

"It is important that students are aware that there are political aspects — and opportunities — in their field, however technical," says Patricia Joffee, administrator of the Political Science Department's Public Policy Program. The one-year-old program is designed for students who want to major in policy studies as well as those who simply want to better understand the government policymaking process, explains Ms. Joffee. It was conceived to "provide a framework for translating social and scientific knowledge into public decisions, and for understanding who is affected by such decisions."

"Students often say they wish they could learn more about public policy — that it would give them a way to look at the world that is practical, based on reality," says Ms. Joffee. "They have an emerging sense that decisions are not based purely on technical data; that they must learn what other forces influence that process." Human skills are very important, she says: how to negotiate, how to show people what they can do in their own interest. She admires students who are attracted to the program: "They have a lively interest in the world around them — they're not narrow. They're willing to see the political implications of the work they do, whatever their field."

Internships are the chief vehicle of the Public Policy Program; they provide opportunities for students to work for government agencies and get academic credit. They can work part time during the year or full time in the summer for ten weeks.

M.I.T. interns claim important positions, explains Ms. Joffee. The students are valuable because they come to their internships with specific technical skills — they understand technical issues — and they have an approach to problem-solving that adapts well to public policy needs. "It's easier to place a student who knows about the particulars of a field even if they may not know about government", she says. "Students who are generally curious about government but think they have nothing to offer find that their technical fields are in demand in government and that they can function well."

One example she cites: an intern with a double major in physics and mechanical engineering was interested in government but didn't think his skills would be useful. But he went to work at the M.B.T.A. analyzing problems with the Green Line and writing a booklet to be distributed to riders. He had to come to Ms. Joffee to say, "I want to work with people — to work with something exciting, current and valuable." (He found himself so involved that he spent extra time answering M.B.T.A. phones during the snowstorm.)

A fairly high number of students are offered paying jobs, get involved, and want to continue the work they began as an intern, says Ms. Joffee. That's fine with her; "I encourage all students to learn more about public policy," she says. — M.L.

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Cirrus fibratus is the technical name for this cloud formation, but to winter-weary members of the M.I.T. community the view over the Briggs Field from Building 7 just said, "Spring's here at last!" The two tallest buildings in the center are Tang Hall (left) and Westgate II. (Photo: Calvin Campbell)



Helping Engineers Be Ready for the Hard Part of Engineering

To be ready for successful engineering careers, students need to know more than engineering science; they also need training to deal with the "unstructured, real-life problems" of their future profession, say David P. Hoult, '57, of the Department of Mechanical Engineering and Robert T. Lund of the Center for Policy Alternatives.

To that end, Drs. Hoult and Lund have for the last four years offered M.I.T. juniors, seniors, and graduate students an elective called Management in Engineering. They use the case history method to show the kinds of management issues with which engineers must deal and the decisions they must make. Some examples:

□ The president of a small consumer-electronics company on marketing: "I have developed very strong feelings about dealers in never wanting them to stand in my way getting a product to people. . . . One has to begin production based upon all the unknowns as to its desirability to anybody . . . I just have no reading on whether anybody wants it or not. That never held me back very much before on products . . ."

□ The production manager of a television-games manufacturer: "We were supposed to be in full production within a month, and then all of a sudden National notified us that they couldn't supply us with low-power transistor-logic, the very night before the shipment was due. Without any other recourse, I spent the next couple of days working evenings and through the weekend modifying the design to be based on (another class of integrated circuits)."

□ A representative of the toy industry to the maker of television games: "The electronic-game business is a game business. You must understand the consumer and the game psychology better than the electronics."

□ The chief executive of a new firm trying to enter the electric-vehicle business: "The inventory build-up (unbalanced because it does not include key parts critical to delivery) coupled with the resultant delivery shortages and the increase in staff generates a critical need for cash. . . . S's parts

are currently an intolerable bottleneck."

□ A public relations man talking to a project engineer: "This is aimed at the guys who are holding the money bags and you keep criticizing everything as though we were writing a technical report. I don't want to misrepresent your baby, believe me, but I'm trying to sell it. We've put a lot of money into its development and we're going to put a lot more into its promotion. . . . I need good copy."

Drs. Hoult and Lund have four goals for their students:

□ They should become aware of the many different roles engineers may be called on to play. "Our students seem generally familiar with the engineer's role as a designer or inventor or entrepreneur. But they know little about engineering roles in production or in the management of technology, (and) . . . they generally have no knowledge of the role of engineering in sales or even in project management."

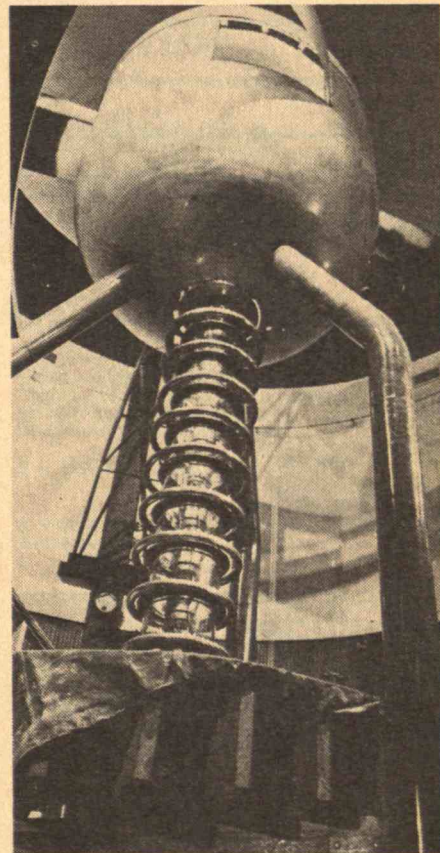
□ They should think about the many different environments in which engineering is carried out — local government, military procurement, consumer durables — and the different requirements of each. "Examples of this diversity are easy to find," say Drs. Hoult and Lund: "Just put a set of practicing mechanical, aeronautical, chemical, electrical, and civil engineers into the same room, provide plenty of beer, and listen!"

□ They should understand the importance of effective communication, both oral and written.

□ They should be familiar with those elements of management which engineers are most likely to encounter.

The students like it. Among comments written to or about the instructors: "Every case study has held something useful and necessary to most engineers but hard to find in any other course." . . . "A nice change from standard textbook teaching as well as a good way to present a wide spectrum of material." Most student frustrations arise early in the term, say Drs. Hoult and Lund, because of the fact that "there is usually no single right answer to a case problem." But these tend to disappear as students learn how to deal with ambiguity — which is, in fact, a major goal of the course.

This one-million-volt "atom-smasher" built by the late Professor Robert J. Van de Graaff of M.I.T. in 1933 is now a highlight of "Atom Smashers: 50 Years" at the Smithsonian's National Museum of History and Technology in Washington. The machine represents the first breakthrough to the million-volt level in the search for higher and higher energies to penetrate more and more fundamental levels of atomic structure, says the Smithsonian caption.



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Leadership Campaign at \$155 Million: 70% of the Goal in 60% of the Time

The five-year M.I.T. Leadership Campaign stood at \$155.6 million on April 1, just three years after its announcement in 1975. Howard W. Johnson, Chairman of the Corporation, told his colleagues at the Corporation Luncheon in March that the Campaign was "in a reasonably good position from which to go forward" toward the final goal of \$225 million.

George Maverick Bunker Professorship

The Martin Marietta Corporation Foundation will establish and endow an M.I.T. professorship in honor of George M. Bunker, '31, who led the transition of the Glenn L. Martin Co. into the Martin Marietta Corp. between 1952 and 1977, when he retired as Chairman of the Board. He was "the architect of 25 years of extraordinary growth of one of America's leading companies," says Howard W. Johnson, Chairman of the M.I.T. Corporation.

Mr. Bunker — his M.I.T. degree was in mechanical engineering — held several industrial positions before becoming President of Glenn L. Martin Co. in 1952, and he continues to hold directorships in a number of companies.

The Bunker Professorship brings to 23 the number of chairs endowed or pledged through the \$225 million Leadership Campaign; seven of these have been funded through corporate support.

The Building 10 Fund: \$1 Million for "One of the Most Common Denominators"

Gifts and pledges to the Building 10 Fund — the Alumni Fund project for renovating Room 10-250 and creating an Alumni Center and the Margaret Hutchinson Compton Gallery on the first floor immediately beneath it — now stand at just under \$1.04 million, and Breene M. Kerr, '51, Chairman of the Sponsoring Committee, is confident that the original \$1.325 million goal will be substantially exceeded. "We have momentum that could possibly carry us to a total approaching \$2 million," he says.

The appeal of Room 10-250 is very strong; it's the one room at M.I.T. in which every student studies and of which every alumnus has memories. Any donor of \$2,000 or more "buys" a chair in the new Room 10-250; he receives the writing arm from one of the old chairs, and his name appears as donor on one of the new chairs that takes its place. Thus far 126 chairs have been sold in this way, and Mr. Kerr thinks the supply of chairs may soon run low.

There have been 15 gifts of \$10,000 or more to the Building 10 Fund; five of these have come from alumni whose previous cumulative giving to the Institute was less than \$1,000. Of 115 donors of chairs, 42 had previously given the Institute a total of less than \$1,000. Clearly, Room 10-250 is "one of the most common denominators for

all of us," Mr. Kerr said at a meeting of the Sponsoring Committee late in the winter.

Educational Policy in the Making: The "Drop Date" Stands Unchanged

In a moment of rare dissent, the faculty early this spring disapproved a recommendation of its Committee on Academic Performance which had been endorsed by its Committee on Educational Policy.

"At issue was the "drop date."

According to existing rules, undergraduates may without penalty drop courses for which they are registered any time prior to three weeks before the last day of classes in any term. The C.A.P.'s proposal would have limited the "drop" privilege to one course between the sixth and 12th weeks of the term.

The C.A.P.'s argument was that too many students abuse the "drop" privilege by registering for overloads in the expectation of dropping courses in which they are doing poorly; thus students' efforts are diluted, overloading is encouraged, and the grading system is distorted. For example, Professor George M. Whitesides told the C.A.P. that many students leave his course in inorganic chemistry — it's required for all pre-medical students — as the "drop date" approaches each term and then register again in the following term; in this way they seek a "running start" on a difficult course in which a poor grade could jeopardize their admission to medical school.

"One does not want to encourage 'bailing out' as a solution to every high-demand situation," argued the C.A.P.

Advocates of the status quo — the unlimited, late "drop date" — argued that students should have a "no-risk" situation in which to assess their own capabilities and that they should be able at any time to slip out of classes in which they're unexpectedly and genuinely disinterested.

When time ran out on the debate, the faculty defeated the C.A.P.-C.E.P. proposal by the narrowest of margins — 72 to 70. An eloquent plea from Dr. Carola Eisenberg, Dean for Student Affairs (she spoke for herself, not for her office), may have been decisive: "The existence of an option . . . provides students with a potential route out of a work overload, one that is in keeping with M.I.T.'s tradition of flexibility and self-determination. . . . The Institute is no country club. With rare exceptions our students work as hard, perhaps harder, than those on any campus. . . . Today their situation is complicated by additional financial pressures and in their anxieties about the job market after graduation.

"The one thing they don't need is greater pressure — or even the perception of greater pressure. . . .

"The change in 'drop date' . . . will be read as a sign that we don't have confidence in students' ability to make choices."

By this statement, wrote Mark James, '78, in *The Tech*. Dean Eisenberg became "in reality a Dean for Students."

M.I.T. and the Intelligence Agencies

How should the Institute and the members of its community relate to U.S. government intelligence agencies?

The question brings with it a host of issues: interrogation of faculty returning from foreign travel, intelligence agency sponsorship of research the results of which will be used for propaganda purposes, intelligence reports on students compiled without the students' knowledge...

To recommend appropriate responses to such activities, Paul E. Gray, '54, Chancellor, has named a committee of faculty and administration to study potential involvements with intelligence agencies. Professor Kenneth M. Hoffman, Head of the Department of Mathematics, is its Chairman; and he says the group will look into "any potential relationship for which the Institute will need guidelines and policies."

A New Structure to Provide Hierarchy and Status for Research Appointments

Ever since its founder's first declaration of his intentions, M.I.T. has been committed to research as well as teaching — and to the idea that the two go hand-in-hand, each strengthening the other. Today, there are almost as many professionals at M.I.T. on research as on faculty appointments.

But the situation of these research appointees is ambivalent, and their career development routes ambiguous, compared with those of members of the faculty. The latter move through ranks — from assistant to full professorships; but members of the Sponsored Research Technical Staff have no such milestones by which to measure status and progress.

Surveying the problem two years ago, a committee of staff and faculty chaired by Professor Frank Press, then Head of the Department of Earth and Planetary Sciences, also found need to assure "... that a full-time research career at M.I.T. will be as attractive as that found in industrial research or in nonprofit, federally-funded national laboratories and centers" and "to maintain research viability (by attracting competent young scientists and engineers to M.I.T.) at a time when faculty growth is limited."

Now John M. Wynne, Vice President — Administration and Personnel, has responded to the "Press Committee" recommendations with a plan for appointing research workers supported through the Office of Sponsored Programs in three ranks: Research Scientist/Engineer, Principal Research Scientist/Engineer, and Senior Research Scientist/Engineer. The latter would be "related" in salary and prerogative (except tenure) to Associate Professor.

The number of such appointments would be limited, especially in the higher ranks, "to prevent the faculty from being 'eclipsed' by a rapidly expanding research staff," President Jerome B. Wiesner told the faculty; he

added with emphasis that the plan does not represent a movement away from undergraduate teaching.

A principal motive is to provide a way to attract competent young people to the Institute at a time when few new faculty posts are available. Faculty growth in the 1950s and 1960s resulted in a "bulge" of teachers who are now middle-aged, with only a few approaching retirement. The new research posts — which are without tenure — could be used to attract young people for whom there are now no places on the faculty.

Christianity vs. Technology? A World Council of Churches Conference in 1979

The World Council of Churches will bring scientists, engineers, and theologians together to "explore the uses of science and technology as transforming forces in the service of humanity and for justice and peace" in a major international conference during the summer of 1979 at M.I.T.

Some 500 participants are expected for the "World Conference on Faith, Science, and the Future"; that will make it the largest event held in North America by the World Council of Churches since 1954. It will be a "serious effort to reinterpret the scientific, technological, humanistic, and religious aspects that have been too much fragmented by traditional disciplinary approaches," say conference planners. They note that an earlier World Council of Churches assembly mandated a meeting such as is now being planned, saying that "Christianity must challenge many of the assumptions underlying modern technological advances."

Computer Costs on a Downslope

Charges for time on the Multics computer time-sharing system have come down — repeat, down — this fall. During the peak demand period, from 11 a.m. to 6 p.m., students paid an average of \$6.50 per unit hour last spring on a complicated schedule with different prices for disk memory space, central processor time, and connection time; now they pay \$4 per hour, flat rate, for the time during which they are connected. Between midnight and 9 a.m. the rate used to average \$3.25; now it's \$2.

The explanation from Weston J. Burner, Director of Information Processing Services, is simple economics: "We have unused capacity," he told Kent Pitman, '80, of the *The Tech* this fall.

Scientific Instruments on Display

Twenty years ago an anonymous donor gave to M.I.T. a large portion of her collection of rare, old scientific instruments. Now, for the first time, they're on permanent display at M.I.T. Historical Collections, 265 Massachusetts Ave., Cambridge.

Included are a Roman balance dating from the first century, a 19th-century Chinese astrological compass, English combination sun dial/compasses crafted in

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"I have the best customers in the world," says Michael Egiros. That's why, after 60 years, "Charlie-the-Tech-Tailor" is still an M.I.T. institution. It was in 1917 that Constantine ("Charlie") Egiros opened a cleaning-laundry-tailor shop at 6 Ames Street, across from East Campus. Now his son Michael (above) continues the tradition of cheerful, understanding helpfulness — especially in emergencies — in new quarters in the basement of the Student Center, where his mother Mary, 80, helps out. About his customers, Mike says, "They keep me young, and they're honest; I've had only three bad checks in 30 years." His favorite: Margaret Compton, whose husband, Karl Taylor Compton, was one of Mike's childhood heroes. (Photo: Lamont H. Solomon, '78, from The Tech)

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the 17th century, a terrestrial pocket globe made in London in 1817, and a German pedometer from the 17th century. Warren A. Seamans, Director of Historical Collections, says all the instruments are "exceptionally beautiful" and rare enough so that a monetary value is hard to establish.

Government and Higher Education

As government support of higher education has increased, so has government involvement — so much so that many colleges and universities wonder if their autonomy is in jeopardy. Funding is necessarily accompanied by regulation, but the government's role in issues like affirmative action in both admissions and employment, privacy, research support and regulation, and financial aid raise questions about "the erosion of institutional autonomy and the constriction of academic freedom."

The quotation is from a statement by Louis W. Cabot, Chairman of the Cabot Corp., upon his selection as Chairman of a commission to study the relations between government and higher education; Mr. Cabot is a Life Member of the M.I.T. Corporation and a former member of the Harvard Board of Overseers. The two-year study will be financed by \$2.5 million from the Alfred P. Sloan Foundation. Carl Kaysen, former Director of the Institute for Advanced Study (Princeton) who is now David W. Skinner Professor of Political Economy at M.I.T., is Vice Chairman and Director of Research; and James R. Killian, Jr., '26, Honorary Chairman of the M.I.T. Corporation, is one of 21 commission members.

MacEachren: Separatism Threatens Traditional U.S.-Canada Solidarity

Though less than 20 per cent of Quebec voters are pledged to the province's separation from the Canadian confederation, the election of a provincial government committed to that goal is "a very dangerous situation" for Canada — "a basic challenge to the existence of Canada as an independent nation," says Allan J. MacEachren, '53, Deputy Prime Minister.

The strength of the government — and even of the country itself — is sapped by the con-



It's a triquetrum, a 17th-century device for taking the altitude of sun and stars — here admired by F. Scott Ferguson, '78, while preparing it for display at M.I.T. Historical Collections. Some 100 such rare, old instruments were given to M.I.T. two decades ago; they're now cleaned, documented, and on permanent display in Building N52.

stant tension between the need for national strength and for cultivating the linguistic and cultural aspirations of the minorities. Mr. MacEachren told members of the M.I.T. Corporation in a luncheon address on December 2.

(Mr. MacEachren, who studied economics at M.I.T. but does not hold an Institute degree, was elected to Term Membership on the Corporation in 1975, when he was Canada's Secretary of State for External Affairs.)

The U.S. has a major stake in the outcome, said Mr. MacEachren. Canada is the largest single customer for U.S. exports, and the two nations "share identical international goals and democratic traditions and institutions." The U.S. needs "a strong, independent ... Canada ... to participate as a partner in world affairs."

That partnership is now traditional: "There is cooperation and consultation on all affairs of mutual interest," Mr. MacEachren assured his audience. And there is "a fundamental desire among many Canadians inside and outside Quebec," he said, to make the changes which are necessary to assure the future of the confederation.



In 46 years as President of the R. E. Runels Construction Co. in Lowell, Mass., Ralph E. Runels, '11, "made money, lost it, and made it again," says Marguerite Lyons of the Lowell Sun. Now, at 90, he's active as a construction and hydraulic engineering consultant, plays a strong golf game, and beats his grandchildren on the tennis court. (Photo: Arthur Pollock from the Lowell Sun)

Ralph Runels, '11: Still an Engineer at 90

The first job Ralph E. Runels, '11, held after graduating from M.I.T. was with the New England Concrete Construction Co. — at 18 cents an hour. "But I didn't think that was enough," Mr. Runels recalled last fall to Marguerite Lyons of the *Lowell Sun*, so he moved on to Aberthaw Construction Co. as a foreman and then to engineering with F. W. Dean Co., Boston, Lockwood Greene Co., and Electric Bond and Share Co.

He's been at it ever since — and at 90 is still active as a construction consultant and registered engineer.

Shortly after World War I — in which he worked as an engineer on the Colt .45 at the U.S. Cartridge Co. — Mr. Runels helped build the Pratt School of Naval Architecture at M.I.T. Then in 1921 he realized the dream of founding his own firm, the R. E. Runels Construction Co. in Lowell; and now his

office is lined with the records of 46 years in business, building such landmarks as the University of Lowell Library, Stevens Mills in Dracut, the Lowell Cooperative Bank, the Christian Science Church in Lowell, the Chalifoux Building in Lowell, and several retail stores.

Since 1967, when he brought the curtain down on his construction company, Mr. Runels has been active as a consultant on building design and hydraulic engineering. Among his clients: Prince Macaroni, Cambridge Tool and Machine Co., and Litchfield Oil Co. of Dracut.

At 90 he puts in a full day in the office of his home in Lowell, drives his own car for business and pleasure, and withstood the rigors of two gala birthday celebrations — one at the Boston Yacht Club where he was Commodore 25 years ago.



Jonny Noyes, '12, and his guest, Mrs. Earl Jansson, banquet at the Royal Hawaiian Hotel in Honolulu on a recent visit to Hawaii.

Note: **William H. Coburn** and his wife are living in Westport, Mass., not Westport, Conn., as reported in the January, 1978, issue of *Technology Review*.

A letter from R. Winston Gardner reports the death of his father, **Albert L. Gardner**, in Braintree Hospital on February 6, 1978, after a short illness. "He had resided with my wife and me for the last two and a half years and had enjoyed excellent health all his life until he suffered a stroke on December 30, 1977.

"Following his graduation from M.I.T. in 1911 he taught mechanical engineering at M.I.T. and Northeastern University for three to four years before joining the Bethlehem Steel Shipyard at the Quincy, Mass., Fore River Shipyard. He worked in the engineering and drafting departments there for over 43 years, retiring in 1957 as the chief mechanical draftsman and turbine designer.

"He made his home in South Weymouth for over 60 years and lived at 31 Wilbur Street until recently.

"He leaves three children: Karl A. Gardner (M.I.T. '34), R. Winston Gardner (N.J. '39), and Marjorie G. Douglas. Karl lives in Northridge, Calif., and Marjorie lives in Lutherville, Md. He also leaves 14 grandchildren and 9 great-grandchildren.

"It is interesting to note that both my brother Karl, who is now retired and active in consulting work, and his son Karl Winston are both graduates of the School of Engineering of M.I.T."

We report the death of **William Goodhue** on November 7, 1977, at the age of 88. After graduating from M.I.T. he moved to Winchester, Mass., in 1933 and was an engineer with the M.D.C. park department for 42 years.

He was a member of the First Congregational Church, Sons of the American Revolution, Ipswich Historical Society, State Engineers, Municipal Employees' Association, and Professional Engineers.

He is survived by his wife, Mrs. Florence Wolcott Goodhue, a daughter, Mrs. Utley W. Smith, a granddaughter, a grandson, and two great-grandchildren. — S.K.

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Cornelius Duyser has had an eye operation which he feels has been reasonably successful, says he can now read sight-saver type. His arthritis is particularly bad, especially in his hands. He made quite an effort to write your secretary in longhand, which I greatly appreciate. Cornelius lives in Connecticut, and I hope to be able to stop and see him on my way east next summer.

Jim Cook has been staying indoors practically all the time. Over the past few years he has had so many broken bones that he is taking no chances of falling on snow or ice-covered walks. Jim has a unique form of entertainment. He has a family of five of six grey squirrels which perform all kinds of stunts on an electric wire which crosses the highway and which can be seen from his window. Sometimes there will be a string of them crossing, one behind the other. He can also see them frolicking in the trees. Jim spent thanksgiving with his daughter and family at Wolfboro and Christmas with his other daughter and family at Marblehead. There was a large gathering each time and Jim says "all went well". His general health seems excellent, but he is very deaf. He hopes to get out and walk a mile or two daily as the weather permits.

The New Year greeted **Jonny Noyes** quite inauspiciously: on January 3 he fell and broke his left hip bone. It must have been quite a serious break; he says there were 36 stitches and that he would be hospitalized for another several months during which period he will visit the "torture chamber" for physical therapy for 30 minutes twice a day. Jonny is keeping his spirits up by his memories of his recent trip to Hawaii. He writes about it again saying, it was "perfect in every detail". It is easy to understand Jonny's enthusi-

asm when you take a look at some of the snap shots which he sent in, one of which is reproduced herewith. We hope Jonny will be out of the hospital long before you read this. I am sure he would appreciate a card from you, at 322 Dunn St., Bryan, Tex., 77801. — **Larry Cummings**, Secretary, R.R.4, Connersville, Ind. 47331

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A December letter from **Roy Parsell** reads in part, "Last June Marjorie and I and the dog spent a couple of weeks at Spalding Inn, Whitefield, N.H. We happened to be there when the Class of 1922 arrived from Cambridge to finish up their 55th at Whitefield. (Randall Spalding was 1922, by the way; it's a fine inn, too.) At dinner someone passed the word around that Marjorie and I were sitting at a table near the M.I.T. class, so out of the clear sky came the word over the microphone that there was another alumnus there and would I please stand. After a few pleasantries I sat down. Later we were invited to their cocktail party in the club house, where I again had to say a few words." In his letter and in a later phone conversation, Roy suggested that our 1979 reunion might well include a stay at a place such as the Spalding Inn, well away from city traffic. Roy said also that he's still prosecuting a few patent applications. — **Charles H. Chatfield**, Secretary, 177 Steele Rd., West Hartford, Conn. 06119

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The sympathy of our Class goes to **Wally Pike** whose wife Ardele died recently here in Cambridge. Many of you will remember her as a loyal supporter of all our Class activities, always attending Alumni Day at M.I.T. and our Class party afterwards.

Due to the high mortality in our Class, we have had to cancel our annual reunion cocktail party on Alumni Day, which we always held at the M.I.T. Faculty Club here. It was always such an enjoyable get-together, but we just have to face it. Sad! We'll all miss it. June, 1915, was a long time. The local men here have kept a good contact with me and I thoroughly enjoy seeing them and talking to them — **Oringer Doane**, **Clive Lacy**, **Horatio Lamson**, **Larry Landers**, **Wayne Bradley**.

Bob Wells spent Christmas with his two daughters and granddaughter in Yosemite. They lived and traveled in motor homes. Bob wrote that his family enjoyed the excellent skiing on the 40 inches of snow on the high slopes, but it was a little too much for him. . . . We hope **Henry Daley** has completely recovered from his illness last summer. After this past miserable winter up north, **Alton Cook** says he has slowed down to the point where he waits to hibernate in California. Good for him!

At our age, time flies! It doesn't seem possible that a year ago, in April 1977, I landed in the hospital with this minor stroke. I have been home some time, hobbling around on a cane — a lot better than being pushed in a wheel chair — and I really feel pretty. Write and ask me how I am doing!

Viking Enebuske died in a nursing home here in March.

All the best to you all. — **Azel W. Mack**, Secretary, 100 Memorial Dr., Cambridge, Mass. 02142

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Last month we reported **Walt Binger's** 90th birthday. A few weeks later we received from **John Fairfield** a photograph showing Walter on horseback making a jump with the caption: "Walter D. Binger recently celebrated his 90th birthday with a day in the hunting field with the Fairfield County (Conn.) Hounds. Mr. Binger was introduced to the sport at 40, and he has enjoyed a half century of interrupted fun with packs in the U.S. and abroad." Fantastic!

This brief note comes from **Willard Brown**: "Still leading a very active life in Santa Barbara,

as a member of many clubs and societies. I'm active in the Navy League and hold the rank of Captain, U.S.N.R., on the retired list."

Carl Redd, '27, sent us notice of the passing of **D.K. Este Fisher, Jr.**, at 85 on January 27, 1978. He had an illustrious architectural career in the Baltimore area. In part, the newspaper wrote: "In 1917, he joined the Army as a lieutenant and was attached to the first American artillery unit to see action in France during World War I. Six months later he was assigned as an instructor at the French artillery school, where he remained until the end of the war, leaving the Army with the rank of captain. After the war, Mr. Fisher returned to Baltimore and joined the architectural firm of Parker, Thomas and Rice, becoming a partner in 1924. During that time he won the design competition for the Princeton University Theater. In 1927, the firm of Taylor and Fisher was established and during his association with that firm Mr. Fisher designed many buildings in Baltimore, including the Federal Reserve Bank, the Baltimore Trust Building (now the Maryland National Bank Building), and the Chesapeake and Potomac Telephone Building. . . . Mr. Fisher was an active member of the American Institute of Architects and served as President of the Baltimore chapter from 1937 to 1938. In 1947, he won a fellowship from the A.I.A. He was a representative of the Institute during World War II and was involved with planning for the national capital and the Baltimore-Washington regional plan. He also was active in civic affairs, serving on the Mayor's Committee of City Planning, the Baltimore Redevelopment Commission and the Greater Baltimore Committee. . . . Mr. Fisher was interested in sports and in his early years was active in hunts with the Elkridge hounds. He also sailed and raced on the Chesapeake Bay and was an avid skier."

We also received notice of the passing of **Arthur Wells** on February 7, 1978. Mr. Wells was born in Wellesley, where he was town treasurer for 32 years and tax collector for 38 years. He was past President of the Massachusetts Collectors and Treasurers' Assn., a former clerk and trustee of the Newton Savings Bank, and past treasurer of the Charles River Shriners Club.

We remind you that our 62nd Reunion will be celebrated June 6-8 at the Chatham Bars Inn on Cape Cod. If you want to attend but don't see how to get back and forth without some help, let us know and we'll try to work something out. Also keep writing and keep breathing. — **Ralph A. Fletcher**, Acting Secretary, P.O. Box 71, West Chelmsford, Mass. 01863

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(Note: The *Review* would like to correct a misprint from the March/April issue. News reported about Helen and Stan Lee should have read Helen and **Stan Lane**.)

Alvah Moody writes from Denver that he is leading a very quiet life, but he and his wife did venture to Chicago last December for a granddaughter's wedding. . . . **Leon R. Westbrook** writes from Oak Ridge, Tenn., that he is still healthy but not so active as he would like to be, due to a slight stroke he had in 1973. He manages quite well with a cane and his wife Bertha's assistance. He moved to Oak Ridge in 1969 to be near his son Russell who is a physicist at the National Laboratory. Leon himself worked at Oak Ridge on the Manhattan Project during the war. . . . **Ned Sewall** writes from Oneida, N.Y., that while he doesn't like to brag about his health, at 85 years of age, he plays golf seven days a week. (But he does admit to using a golf cart.) . . . **Phil Cristal** says he is actively working as a registered investment adviser, nine or ten hours a day, and loves it.

A letter received from Mrs. Joseph W. Morgan advises that her father, **Richard T. Whitney**, is not well, suffering from arteriosclerosis and requires constant nursing care. Fortunately, his two daughters, Barbara and Janie, a granddaughter, and his two great-grandchildren, live nearby and give him considerable enjoyment and comfort. The Class extends to Dick our best wishes. . . . In December we reported the death of **Francis Goodale**. His

estate included 32 acres of farm and woodland in Hudson, Mass., which had been in his family for seven generations. Francis left the property to the New England Forestry Foundation and it will be known as the Goodale Memorial Forest.

A.P. Sullivan discussed an interesting item in a letter to Stan Dunning. A.P. is our class expert on clocks, and the question was why do most clock dials with Roman numerals use III instead of IV. A.P. says the most widely accepted conclusion is that the IIII balanced more nicely with its opposite number VIII. . . . **G. Hobart Stebbins** is still active in his business as President of the Lake Union Drydock Co. of Seattle, Wash., but his son "Hobie" carries most of the load. His company has seven floating drydocks with capacities of 3,600 tons. Hobie's son Bob graduated from M.I.T. in 1951, and lives in Old Greenwich, Conn. A daughter lives in N.H. Hobie has a 45-ft. power cruiser that he uses to explore the islands and inlets in Washington State and British Columbia. We hope that when Hobie and his wife Enda visit his children and grandchildren in New England, he will look up some of his old friends.

Dick Loengard reports that at the January meeting of the 1916/1917 luncheon at the Chemists Club in New York on January 17, those present were **Clarence Seely**, **Bill Neuberg** and Dick representing 1917. The weather was bad and prevented others from making it.

A marvelous letter from Admiral **W.A. Sullivan** recounted his very extensive travels to eastern and western Europe and Egypt. Sully and his wife Bess live in La Jolla, Calif., where they have a condominium fronting on the ocean. Last year they spent four months in Greece, visiting the famous archeological and historic places, as well as many of the Greek Islands. They then went to Egypt for two weeks where they were fascinated by the Cairo Museum. They spent last December in Honolulu. Next they plan to visit Czechoslovakia, Poland, and Yugoslavia. Bess can speak Czech, so they get by very well and have even made some friends there. It would seem that Sully and Bess must have considerable energy to keep up with such a program. More power to them.

We regret to report the following deaths. **Win McNeill's** widow, Carolina, died in August, 1977. Win is remembered as President of our Class and was very active in our Class affairs for many years.

. . . **Augustus P. Farnsworth** died at his home on King Rd., Etna, N.H. . . . **Harry A. Wansker** writes that his wife, Isabel Alden Wansker, died on December 20, 1977. Isabel was a descendant of John and Priscilla Alden. She leaves Harry and two daughters. Harry is active as President of the Sarasota-Manatee U.S. Navy League, and is a member of other societies, including the Florida West Coast M.I.T. Alumni group. — **William B. Hunter**, Secretary, 185 Main St., Farmington, Conn. 06032

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It is five days to Spring — the Great Blizzard of 1978 has faded away a little. Just as the streets were becoming almost normal another snow storm is with us — maybe eight to ten inches this time. Let's look forward to our 60th in early June with warm sunshine and good fellowship. I hope you all will make a special effort to be here for this event which is so meaningful to us.

My Christmas mail is still yielding dividends. I am particularly happy to print this newsy note from **Rolf Knudsen** from Norway. "I had the intention to send you a picture of my class, Course XIV of 1918, which I have had on my bedroom wall for over 60 years. Now I see that **C.C. Fuller** has sent in the same picture and that it has been published in *Technology Review*. I am wondering how many of the fellows are still alive. I hear from **Julian Avery** every year, but I have lost contact with the others. You propose that I should come over to the 60 years anniversary in June, but I am afraid it is too far for my age. I was at M.I.T. 30 years ago and met a few of the fellows I knew.

"You also ask me to tell a little about what has happened to me the last 60 years. In 1918 I became an assistant to Professor E.E. Northrup in



Mr. and Mrs. Julian Howe, '18, strolling down the street in Canterbury, England

(September, 1977).

Princeton, N.J. I worked with him for a year in his work to develop a high frequency furnace. I had a very interesting time, and Dr. Northrup became my friend for life. In 1919 I went home and had a couple of years with illness before I started to work in a firebrick factory, owned by my family. I was in charge for that factory nearly 40 years with good results. The factory manufactures silicon carbide articles and insulating refractories as special products. I was also one of the directors and member of the board of a shipping company, controlled by my family. The work gave me a very interesting life.

"I have had the good fortune in life to have very good friends and still have a few, but at our age most of the friends and family disappear. With best regards and good wishes."

Sherman McGregor is still active: "Your card found me hale and hearty as much as can be expected. I lost my wife last April and that hasn't made life any pleasanter for me. But I continue to do my usual routine — V. A. Hospital, Boy Scouts, and V.W.W.I. and keep busy; but life is very uneventful indeed! I've given up acting, as it takes too much time that I don't have for it. But I'm doing very well and keeping very fit. Sorry but I won't be able to make the 60th reunion of the dear old class of 1918. I shall be otherwise engaged."

Al Murray's greeting follows: "I am a retired electronics engineer turned into an investment adviser. No news; just about the same statistics as the average '18er — vis: married, with three married 'children'; two grandchildren; busy and in good health."

Eaton J. Clogher tells of a visit to M.I.T. in 1976: "The Monday following Thanksgiving, 1976 I went to Cambridge with my oldest daughter, her husband, and their two children. The son-in-law had to give a lecture at M.I.T. on some phase of nuclear energy he is engaged in. It was a drab, drizzly, raw day. While the son-in-law was doing his talk we wandered about in some of the old buildings. I was disgusted — gloomy ill-lit corridors, sloppy dressed people shuffling along, heads down, hell, it looked like an old-time poor farm. The place was dirty. Frankly, I wrote the place off. I had not previously been in this 'nut factory' since the late 1950s and early 1960s when my youngest daughter was there. I'll take one more chance; possibly it will look better in June. Yes, I would like to be present at the 60th reunion in June and trust that nothing will short circuit me on this one."

Dave McFarland writes: "We lead a rather quiet life down here. In May we had lived in the home we built here 50 years ago, and it is but a couple of squares from the home where I was born. However, in my work with the development and applications of explosives I did get into every state except Alaska and Hawaii. It was interesting to see some of the big dams and tunnels of the country under construction."

"This year I have a granddaughter from New Canaan, Conn., who lives at 140 Bay State Road in a Boston University dormitory; and I lived not too far down the same street at the Beta House. She seems to be pleased with her selection of a college and with Boston and vicinity."

"We have a grandson with Mobil Oil Co. at Scarsdale, N.Y., another in Baltimore who graduated from Denison and is with a good real estate firm."

"We hope to go to Baltimore for Christmas with our daughter and family. Her husband is an internist, has a wonderful practice and teaches at Hopkins. He is now President of the Johns Hopkins Alumni Association, and I hope he does not do too much and ruin his health."

"Except for two cataract operations that forbid my driving at night, I have been fortunate to be able to keep going; I try to walk several miles each day in winter and farm an area of ground in summer."

From Mrs. Joseph D. Haas comes this news of her father, **Wendell Kayser**: "Dad appreciated your card and interest in his joining the class of '18 for its 60th reunion. He asked me to write to let you know that he (and my mother, too) are unable to travel."

"The Kaysers moved to my home three years

ago because their health is very poor. They now live at Ave Maria Guild Home, just ten miles from my home. They are very interested in what is going on and keep informed of the news and world events, but they are terribly frail."

Len Levine writes from Pompano Beach, Fla: "We have been here now a month and expect to stay until March 15. **Bill Weiscope** is only two blocks from us, and I had a long phone talk with him yesterday; expect to get together with him soon. His wife Rose (who I knew before he did) has been in a rest home for two years, so Bill is leading rather a secluded life.

"**John Kilduff** in Clearwater is about 200 miles from here on the West Coast. However, I am dropping him a line. Who knows, we may make it together some day."

Bob Collier writes that he is still active and producing.

The next two letters from Clarence Keller and **Paul McAllister** show more interest in the Course XIV picture. Clarence writes: "I've just written a note to Paul McAllister in reply to his enclosed letter. I was surprised to hear from Paul as it has been quite a few years since we used to exchange Christmas greetings. Incidentally I had no other response to the Course XIV photo.

"I stay in the house and keep warm most of the time. I had to stay in during the blizzard week as the snow piled up and blocked all three of my doors. In front of the house it drifted up to the tops of the windows so I couldn't even see out! Nothing like it I guess since 1888.

"I'm glad to hear **John Kilduff** is doing well. It was smart of them to go to Florida. I had a card from Elinor and must drop them a line and send down a barrel of snow!"

Paul's letter to Clarence went! "Naturally I was glad to see your letter in the May *Review*, with the accompanying picture. I see in the picture fourteen alert and capable-looking young men, with no scraggly whiskers or streaming hair. But according to the 1975 Alumni Register, there are only six of us left, sad to say.

"After all those years, what are we like now? Older, of course; wiser and more confident, certainly; richer, all of us, I hope. And yet I suspect that underneath we haven't changed much in 60 years.

"It is, I fear, the only time my picture will ever appear in the *Review*. I had thought of making it by coming on to some outrageous advanced age. Then in the June *Review* I noted that the Secretary of the Class of 1899 reached the age of 100. He got a few sentences of space, but no picture. So I guess it will take more than 100 to make it."

I am indebted to the M.I.T. News Service for an item from a New Hampshire paper on **Bill Bassett**: *Col. Bassett helped 'Lindy'.*

"It was revealed last week by the Milford Cabinet that a Wilton resident made an important technical contribution to the success of Charles Lindbergh's flight to Paris 50 years ago. Col. William H. Bassett, Jr., now 80 years old, retired, was a metallurgist employed by the American Brass Co. in Ansonia, Conn., when he was asked by the Wright Aeronautical Co. in Paterson, N.J. to see if he could produce a metal that would not soften under heat, and that would stand repeated pounding without becoming brittle.

The young metallurgist went to work on the problem. The result was an alloy called Avialite Bronze. A supply of the metal was delivered to the New Jersey company. Many weeks later the American Brass Co. received a telegram thanking them for having helped make the Lindbergh flight a success. Avialite Bronze had been used to make the valve seats in the engine for the Spirit of St. Louis. The alloy was used for many years in all Wright Aeronautical and Pratt and Whitney engines.

"Col. Bassett said this week that he hardly realized the significance of what he had invented at the time. He was with American Brass from 1919 to 1942, when he entered the U.S. Army as an Ordnance officer. He was with the Army of Occupation in Japan, and during the Korean conflict he was in charge of building the pontoons (from wood) that were used by U.S. Forces in the invasion of Inchon. Among his other professional

achievements was the development of a metal used in electrifying railroads."

The Boston papers reported the death of **Wingate Rollins** on March 9. He has been a most faithful member of the class. In the past years he has travelled extensively — we were fortunate to see his movies of the trip over the Himalayas at a recent M.I.T. 1918 news reunion. — **Max Seltzer**, Secretary, 60 Longwood Ave., Brookline, Mass. 02146

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Barbara and **Don Way** have been visiting in Florida. Don visited with me and we talked at some length about arrangements for our 60th reunion, June 1979. We hope to arrange for headquarters in Cambridge or Boston to avoid transportation problems to the Cape. Put the date on your calendar and let's have a good turnout.

A nice note from **Dean Webster** from Phoenix, Ariz., was just received, with greetings to me and the class. . . . **George Bond** writes, "Still enjoying good health and am involved in many community activities. I plan to go with other members of a tour group on a trip to Yugoslavia next March." . . . **Roger Hall** says, "I'm in good health and still active in building construction in this area. Would be delighted to see any classmates visiting or passing through the nation's capital."

We are sorry to report that **Edward Moody** died in Nashua, N.H., on January 8, 1977. . . . Mrs. **Ernst F. D. von Voss** wrote from Brenham, Texas, that her husband passed away a year ago from a non-malignant brain tumor, removed in 1972, but reformed in 1976. . . . A letter from Bill Hunter advises us that **Herbert W. Best** died the latter part of September, 1977. He was Associate Professor of Automotive Engineering at Yale for 33 years. He and his wife Ethel retired to the Island of Mallorca about 15 years ago.

Francis A. Weiskittel had this hard luck story: "Life gave me a hard knock in November. Neighborhood teenagers broke into our home, completely ransacking three floors and basement, and stole a large volume of articles such as heirlooms. All this was while my retarded son and I were away for an annual visit to Disney World and a week's cruise in the Caribbean. After seven weeks of diligent work the house is organized again."

Howard W. McClintic of Gulfstream, Fla., died on January 30. He had been troubled with arthritis for some years.

A note from **Dean Webster** from Scottsdale, Ariz., says he is living the life of total retirement: some golf, some swimming in the pool, and a bit of bridge.

We regret to announce the death of Iva, wife of **Ev Doten**. Iva had been in and out of the hospital this past year. She attended many reunions with Ev and was one of our most enthusiastic reunion guests. Ev says he will continue to live in Detroit and is looking forward to our next reunion.

Best wishes came from Margaret and **Roy Burbank**. — **Eugene R. Smoley**, Secretary, Apt. 11E, 50 East Rd., Delray Beach, Fla. 33444

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I've received no response from our remaining classmates, so I must assume that you're all too happily occupied to spare a line for the Secretary.

They tell me that one sign of approaching senility is the tendency to repeat oneself. I confess I cannot remember telling you about the unfortunate demise of the good old ship, *Peter Stuyvesant*, berthed at Pier 4 where we had our enjoyable 55th reunion banquet. The ancient Hudson River Dayline ship turned over on its side during the famous blizzard of '78, taking along its priceless antique contents collected by the owner; it is, alas, beyond rescue. I was reminded of this sad event by a warm letter from **Joe Margolis'** widow, Ruth. She commented on the packs of playing cards that were sent to her because of Joe's inability to be present at the 55th. Ruth says, "I shall treasure them and use them whenever I entertain special friends of us both."

A letter from Lindsay Russell, '49, to **Perk Bugbee** justifies a quote. He writes, "Early in 1966 we sought advice on fire safety, alarm systems, etc. You told us to install a sprinkler system and be done with it. For a dozen years on my occasional visits to the fraternity house I have peeked into 'sprinkler alley' in the cellar to see that the gauge was reading the Cambridge water pressure, never suspecting that these would ever do anything but stand silent watch for decades more. Early this morning a mattress caught fire from an electric heater. A sleeper in the room awakened from the flames and escaped from the small room. A sprinkler head opened and the fire was soon out. Damage was minor. About 40 men were sleeping when the fire occurred. Herewith is the sprinkler head from your old house, in fact, there at your behest." A heartwarming ending to a nice, true tale. — **Harold Bugbee**, Secretary, 21 Everett Rd., Winchester, Mass. 01890

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A February letter from **Wally Adams** of Middletown, Ohio, said in part: "Your quote of **Grant Miner** in the December *Review* (on the Sacco-Vanzetti case) reminded me that I was also a member of that surveying crew. The map we finally prepared was on a scale of one in. equals ten ft. and was over 35 ft. long. It covered more than one wall in the court room. We were working as experts for the defense and Professor Breed always felt the conviction was not justified by the evidence.

"We're setting new snow records every day. A week ago I thought my barometer had broken; it was the lowest I have ever seen it — 28.60. The official weather report said 'lowest ever on record'. Anyway, I have been getting exercise shoveling snow." Who hasn't?

Dorothy Wenick spent a five-week vacation with her son Martin during December and early January in southern Italy. Martin is First Attaché at the American embassy in Rome. . . . Betty Patton wrote that her mother died last September. "I miss her very much for we had 12 happy years together since she came to live with me in 1965. I will continue to live right here (in Dallas, Penn.) in my comfortable little home in the country and continue my work at Temple B'nai Brith. I love my work — most challenging." . . . **Irv Jakobson** took a quick trip in December to Nice, to look over the oceanographic boat used by the Cousteau Society. He was planning to do some sailing in the Virgin Islands, having chartered a 35-foot sloop for two weeks in late February and early March.

Cac Clarke reported that he and Maxine went to the 55th wedding anniversary party of Alex and **Munroe Hawes**. A note he received from Catherine (Mrs. Harry) Field told of a slight stroke she had last August, but a fine recovery. Her family were coming home to Hawaii for Christmas — two from Virginia and one from Seattle. Cac's big thrill this past year was his eldest granddaughter's graduation from college. Maxine is still busy in art groups, painting portraits and exhibiting. Cac himself is cutting down his hours on newspaper work. In recognition of his weekly by-lined column of events of the American Revolution, he received the "Patriot of '76 Award" from the National Society of Sojourners. As a 1955 Bronze Beaver holder, M.I.T. has put Cac on the Alumni Council and "if I can make it to 1981, I am invited to *The Tech's* 100th anniversary. Sad to say, I'm the only survivor of the managing board in our senior year when I was editor-in-chief."

The Lloyd family had a big family reunion at Christmas at their daughter Barbara's in Westwood, Mass. Emma wrote that their house in Westerly was broken into last October and all their flat silver stolen. . . . **John Mattson** told of an abdominal operation this past year but said he is hale and hearty now. His daughter Muriel was elected President of the Radcliffe Alumni Association. . . . **Bob Miller's** Christmas card was another photographic triumph with 28 of the Miller tribe portrayed.

Another "life history" of a California classmate has arrived in a letter to **Sam Lunden** from **Grant**

L. Miner. Grant wrote: "I've always considered myself a very lucky individual. I was shot with luck when I graduated from M.I.T. in 1921. A job was waiting for me — in addition I was taken in as a third partner in a 'going' contracting company. They had a signed highway contract so lucrative I was able to pay off within six months of graduation all the money I'd borrowed for my education."

"Contracting suited me to a tee. In what other profession would anyone be able to cash in on all these benefits? 1) You're your own boss. 2) You can see the end results of your efforts — the finished job. 3) If you are a gambler by nature, this will fulfill your wants — a contractor bets his bankroll every time he signs a contract. 4) The work is never boring. Each day presents a new set of problems requiring its solution right now. 5) The skill and judgment required in bidding keeps you on your toes. 6) The thrill of being low bidder and being awarded the job."

"So that's been my life. I've completed hundreds of contracts in Wisconsin, New Mexico, and California including highways, bridges, residences, reservoirs, a fish hatchery, country clubs and golf courses, manufacturing plants, hospitals, schools, mountain pump lifts and canal structures."

"We were speaking of luck. On January 16, 1933, in the very depths of the depression, I prevailed upon Marianne Stockton McKee to marry me. My luckiest day! Our first home was in an adobe house on the Rio Grande River, where both plumbing and water were 'outside.' Marianne cooked on a wood-burning stove and water was pulled up from the well in the proverbial oaken bucket and heated in a wash boiler for our baths. Our rent was \$13 a month. We moved 18 times in the first 14 years of our marriage."

"With the exception of four years in the army during World War II, we did the contracting thing until 1951. I served as Operations Officer in the Corps of Engineers, first in the San Francisco District, then later in Manila. The jobs in Manila included rehabilitating the main post office, the railroad station, the Manila Hotel, and constructing the 'Voice of America' broadcasting station."

"In 1951 I found my speedometer had clocked 40,000 miles during 1950. That meant 40,000 miles on me, too — more than enough. Marianne and I decided to liquidate the business. Then we went to Europe to take a long-delayed honeymoon. On our return we were looking around for new worlds to conquer. We bought a plumbing, heating, air conditioning and sheetmetal business that was sick and in deep trouble. It took three years to swing it around from red to black ink but the rewards were not commensurate with energy expended and in 1961 we liquidated."

"And now? I'm still riding my lucky chariot as a consultant in business and contracting. Currently I'm doing some work for the Zenitaka Corp. — a Japanese engineering and contracting firm interested in doing work in the United States."

We sadly report the deaths of seven classmates:
William A. Collins of Holbrook, Mass. — January 17, 1977

William R. McKee of Terre Haute, Ind. — June 28, 1977

Paul H. Rutherford of Nahant, Mass. — July 13, 1977

Hyman J. Levensohn of Framingham, Mass. — September 28, 1977

Robert B. Frost of Allentown, Penn. — October 29, 1977

Robert P. Kite of Larchmont, N.Y. — November 2, 1977

Henry M. Lane of Belmont, Mass. — December 27, 1977

The news of Paul Rutherford's death came from Marion Chutter; he was one of the Hexaphas in our Class and attended many reunions. His business career was with General Motors Corp., where he was General Manager of the Delco Appliance Division.

Robert Frost was employed as a chemical engineer for Lone Star Cement Co. and by Fuller Co. He served in the U. S. Navy Sea Bees during World War II. **Henry Lane** served as laboratory instructor at M.I.T. from 1923 to 1930, was Research Associate in the Underwater Sound Laboratory at Harvard and at Lincoln Laboratory from

1942 to 1946, and returned to M.I.T. in 1952. He was Radio Editor for the *Boston Post* from 1924 to 1942. Our deepest sympathy goes to the families of these classmates.

Phil Coffin took his pen in hand to write your Secretary about his efforts to get action started on the fuel situation. "I have written letters to the press and prominent individuals, trying to get our government to assume a realistic stance on the energy crisis. I wrote to James Schlesinger back in September and more recently to the *U.S. News and World Report*. I received replies from both. My campaign has consisted of trying to get the government to do what it should have done when the Arabs first blew the whistle on us — convert to methanol with all possible dispatch. The fuel is not nearly so expensive to make as stated in a *U.S. News* article about using alcohol as a fuel for automobiles. Its exhaust is like a dream in heaven to ecologists — like human breath without garlic and burps. Furthermore, just reintroduce the Stanley Steamer and you don't have to mix gasoline and methanol."

The January 31, 1978 issue of the *Town Hall Journal* (Los Angeles) has a picture of Assistant Secretary **Sam Lunden** being presented a special plaque "in recognition of his outstanding leadership and 35 years of service to Town Hall." Sam is a past President of this organization and more recently Chairman of their Endowment Fund. Congratulations! A recent letter from Sam told of having Rosalie and **Ted Rose** over for dinner.

Dorothy (Mrs. **Joseph**) **Wenick** reported a thrilling experience during her stay in Italy with her son Martin over the holidays. While staying at a hotel in Sicily, two mile high Mt. Etna started to erupt and from their bedroom windows they could look out at night to see flames rising in the sky and three molten streams of lava running down the mountainside, and reaching the sea. Dorothy said they sat up to all hours watching the spectacle. Martin will finish his assignment at the Rome Embassy this summer and return to Washington pending assignment elsewhere. A few days after returning from Italy, Dorothy took off for West Palm Beach to escape the winter cold in New Jersey. While in Florida she bought a condominium apartment in Coconut Creek, six miles inland from Pompano Beach, where she will spend future winters.

Another Florida resident this winter was Betty (Mrs. **Dugald**) **Jackson** who returned to her usual haunt in Mt. Dora. She spent Christmas in Roanoke, Va., at her son Daniel's home and they were joined there by her son David and family — "a merry group of ten to enjoy each other."

A postcard from **Bob Miller** dated February 28, 1978, in Barbados, said: "Finishing a pleasant week, swimming and relaxing in 70° to 80° temperatures. Tomorrow we fly to Mexico City for 12 days including a three-day trip to Oaxaca. We will visit our daughter's family and hope to have lunch with Graciela and **Helier Rodriguez** and **Viviano Valdes**. On our way home, we spent two nights with friends in Orlando."

The **Haywards'** annual trek to Sarasota, Fla., ended on March 1 when we headed back to find two feet of snow still on the ground at home. Even with chilly weather (for Florida) it was a lot warmer than New Jersey and we enjoyed our usual round of cocktail or dinner parties with one or more of our 1921 classmates. This included Claudia and **Josh Crosby**, Millie and **Herb Kaufmann**, Kay and **Larcon Randall**, Alice (Mrs. **Robert**) **Felsenthal**, and Beth and **Whittier Spaulding**. A luncheon at Martines restaurant brought out **Tom Dutton**, the **Crosbys**, the **Haywards**, the **Kaufmanns** and **Larc Randall**. Another day Graciela and **Helier Rodriguez** drove down from Tampa to have lunch with us. It was exciting to see Florida gallinules swimming in the pond in front of the Kaufmann's apartment. And what a delicious dinner we had with them! This wonderful couple is celebrating their 50th wedding anniversary this June with a flight to London and a North Cape cruise.

Aren't you glad Spring has come? — **Sumner Hayward**, Secretary, 224 Richards Rd., Ridge-wood, N.J. 07450; **Josiah D. Crosby**, Assistant Secretary, 3310 Sheffield Cir., Sarasota, Fla. 33580; **Samuel E. Lunden**, Assistant Secretary,

Lunden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013

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We have news from many of our southern friends. **Frank Kurtz** of Delray Beach tells us of his tennis matches three times a week and daily bridge games. . . **Oscar Horowitz** reports that he is continuing his golf at Pompano Beach where the course is outside his living room window. He is celebrating this March because he broke 100 for the first time this year and plays practically every day. It seems that those who exercise the most get younger all the time. So let's all adopt that schedule — even if it means shoveling snow, slowly.

Ken S. Morgan writes from Balboa Island, Calif. He lists many activities, both present and past, for Western Electric. He deserves a special article for his acknowledgment of our need for news.

We phoned **Parke Appel**, who reports that he and Madeline are enjoying Venice, Fla., more than ever and hope for Class visitors driving along the West Coast. Parke is busy in civic activities that keep him in full-time operation for the good of many others, including the Class of 1922.

William G. Rapp of New York has retired after twelve years as safety consultant for a structural steel fabricator and erector and 36 years with Bethlehem Steel Corp.

Charles C. Bray of Illinois entered M.I.T. in 1916 (Class of '20) and was one of the first freshmen in the new buildings. Then on to France and World War I and to the University of Toulouse. Charles returned to M.I.T. and obtained his degree with the Class of '22. At present he is 80 years old and still active. He is a Sales Promotion Consultant for building materials for the Osmose Wood Preserving Co. of America.

C. Randolph Myer, Jr., of New Hampshire is still running a business, but was compelled to lay off last spring because of health, and thus missing the 55th Reunion. He hopes to be able to attend the next one.

We received a short note from **Spencer H. Lane** of Minnesota saying he is now a retired C.P.A. . . Mrs. **Bertha S.W. Dodge (Wiener)** of Burlington, Vt., has written a book *Tales of Vermont Ways and People* published by Stackpole Books, Harrisburg, Vt. She has also completed the manuscript for a book for Wesleyan University Press. The book is a narrative written by an American sealing captain who was marooned on the Falkland Islands during the War of 1812. Bertha has collected much peripheral material and is writing a lengthy introduction.

G. Dewey Godard of Marblehead, Mass., was unable to attend the 55th Reunion because of a serious operation. He sends his best to all Classmates. . . **John S. Williams** of Richmond, Va., has a summer home at Strawberry Hill Rd., Woods Hole, Mass. He is still active in business and tennis. He would like to see local alumni and hopes to reactivate the M.I.T. Club in Richmond.

Robert L. Hallock of Boca Raton, Fla., has over 30 successful and paying inventions and — wishing to help creative young people — has written *Inventing For Fun And Profit*, a manual on how to develop, protect, and sell a patentable idea at a minimum expense, and with maximum profit and satisfaction. The royalty from the book is being turned over to Professor Yao Tzu Li of M.I.T.'s innovation program, who was kind enough to write the book's introduction. The book is being published by Harmony Books Dept. Crown Publishing Co. and will be on sale about April 1.

John Strieder of Massachusetts writes that he will be Visiting Professor of Thoracic Surgery at the University of Pennsylvania in April.

Kenneth G. Merriam died just two days after a professorship named after him at Worcester Polytechnic Institute had been filled by a former student. In the 1930s he did pioneering work on pitot-static tubes, widely used in measuring aircraft speed. He was awarded an honorary doctorate in engineering from W.P.I. in 1964. He was an Associate Fellow of the Institute of Aeronautical Sciences and also of the American Institute of

Aeronautics and Astronautics. Ken was presented a citation for outstanding teaching in 1961 by W.P.I. trustees. He was past President of the W.P.I. Chapter of the Society of Sigma Chi. He was a life member and fellow in the American Society of Mechanical Engineers and a member of Alpha Chapter of Tau Beta Pi. Ken was elected to the Wisdom Hall of Fame and presented the Wisdom Award of Honor in 1970. He was a life member of the American Society for Engineering Education. Ken leaves his wife, Alice E. (Blandin) Merriam and two daughters.

Word has also been received of the death of **Lester Clark Lewis**, Minister Emeritus of All Souls Church, Unitarian, in Washington, D.C., a research physicist, and former minister of the First Parish Church in Lexington, Mass. Dr. Lewis received his B.S. in physics from M.I.T., his M.S. in chemistry from Chicago, and his Ph.D. from the Molecular Beam Institute of the University of Hamburg in Germany in 1931. In 1939-40, he was a physicist in the textile foundation of the National Bureau of Standards in Washington, and during early World War II was in the Radiation Laboratory at M.I.T. He also held Unitarian ministries in Brockton and New Haven before becoming Head of the Physics and Mathematics department of Wagner College on Staten Island in 1956. He later spent a year as Curator of Science and Technology at the Smithsonian Institute. He leaves his wife, Helen, a son, two daughters, two sisters, and nine grandchildren.

The sympathy of the Class is also extended to the family of **William I. Horlick** of Hallandale, Fla. — **Whitworth Ferguson**, Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horowitz**, Assistant Secretary, 3001 South Course Dr., Pompano Beach, Fla. 33060

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In addition to those already reported by **Pete Pennypacker** to be attending our 55th Reunion in June, the following also intend to come: **L.E. Barstow**, **P.S. Wilder**, **F. Almquist**, **P.L. Coleman**, **R. Cutting**, **R.M. Meekins**, **A.E. Perlman**, **J.E. Silvasy**, **E.D. Wilson**, and **F. de LaMacorra**. This brings the expected attendance of classmates and spouses to 117 persons. It promises to be a really good time.

Atherton Hastings sends his regrets, as he has already planned to visit his daughter and her family during the reunion period.

Other news is sparse this month, so we must fill this column with the only travel news brought to our attention. Marge and **Tom Rounds** spent six weeks in Southern California: two weeks with our son's family in Los Angeles, and a month at a Solana Beach condominium. It rained for almost four solid weeks, but Marge and I had some fun in spite of it. . . . Helen and **Lem Tremaine** spent the month of February at the Cloister in Sea Island, Ga. This included a long weekend with Helen's grandson in Atlanta. . . . **L.H. Poor** writes, "My entire year was spent making Brownie points with members of the family as tour conductor. It's my first year with no professional activity."

Horace W. Briggs died on December 6, 1977. He was a clergyman and had pastorates in the Church of the Open Word of Newtonville, Mass., and the Church of New Jerusalem in Fryeburg, Maine; at M.I.T. he was in Business and Engineering Administration.

From Mrs. Hayes we learn of the death of her husband, **Alvah G. Hayes** on December 12, 1977. Al received his degree in Business and Engineering Administration with our class, and in 1946 was awarded a Master of Education degree from Boston University. His career was spent in the educational field in North Andover, Mass., progressing through teaching and athletic coaching duties to Headmaster of the North Andover High School. He was acting Superintendent of Schools in that town, retiring in 1966. He was active on several state educational committees, on the local teacher's association, and with local service clubs. — **Thomas E. Rounds**, Secretary-Treasurer, 990A Heritage Village, Southbury, Conn. 06488

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We regret to report the loss of **Bill Correale**, one of our most ardent supporters of class activities, the Alumni Association and the Alumni Fund. He passed away February 22, 1978 in St. Clare's Hospital, New York, after a brief illness attributed to cardiac arrest. He was one of the first graduates of the hydroelectric option in civil engineering and was circulation manager of *The Benchmark* 1922, the annual publication of the summer session at Camp Technology, East Machias, Maine. Bill launched his career as a draftsman and progressed in various construction administrative positions. In World War II, he was a Lieutenant Colonel in the U.S. Army Corps of Engineers. Subsequently, Bill was acting commissioner of New York City's Department of Water Supply, Gas and Electricity and, in 1959, executive vice president of Depot Construction Co. in New York City. In 1962, he became a consultant with the Center for Urban Environmental Studies at the Polytechnic Institute of New York. Bill also served as technical director in the writing of the current New York City building code. To Betty and the family, we extend our sincere sympathy.

Hazel and **George Glennie** (Andover) send a picture of themselves, saying, "Here is the proof that we finally made it to our 50th wedding anniversary party. We now have seven grandchildren and are fortunate that they are doing well and live near us." . . . **Max Ilfeld** (New Mexico): "We are alive, healthy and busy. We go to Green Valley, Ariz., for a ten-day visit in January, then to Laguna Hills, Calif., for February and March. It is really criminal to leave our own fine climate — no snow, no rain, dry-dry. There is golfing daily and much social activity. Many sneaky people from the Northeast have just discovered that New Mexico is part of the U.S.A., and our influx is considerable." . . . **Bill MacCallum** (Los Angeles): "Since returning from our extended cruise in July, we have been in Cotuit, Mass., constantly. In November we drove out here for the winter."

Nish Cornish writes: "Luisa and I continue to be very active with our 11 grandchildren in Mexico City and three more in Monterey. They are with us every Sunday in our large garden. Our 20-year-old is attending Monterey Tech which was patterned after M.I.T. and was founded by a 1914 graduate, the big industrialist of the area (brewery owner, too)." . . . **Mike Amezcaga** (Maryland): "As time goes by there are less and less of us and nothing that we can do to change life. God willing, I am looking forward to seeing you at our 55th. It's just 18 months away!" . . . **Paul Blampied**: "I have become a refugee from Taxachusetts. Sold my home on that lovely island of Squantum, swallowed the anchor and bought a condominium in Boynton Beach, Fla. After ten years of retirement, decided to try to catch up with inflation and firmly believe that half of the people in New England will have to move south. Am healthy enough and still can get aboard freighters to enjoy the beauty of this lovely planet. Will summer near my kids in Bow, N.H."

The **Joseph R. Mares** '24 Career Development Chair in chemical engineering has been established at M.I.T. through the donations of friends and family. Joe passed away April 13, 1976. It will enable the Institute to expand its support of promising faculty in a department which has a distinguished history and which has attracted an unusually strong group of young faculty members in recent years. Joe had a lifelong interest in the training of chemical engineers. During 1958-59 he was a consultant to President Eisenhower's Science Advisory Committee.

Ralph E. Winslow died January 14, 1978, in New Rochelle Hospital. He was awarded an S.B. and a master's in architecture. After graduation he worked as a designer for several Boston companies receiving the Rotch Traveling Fellowship for 1928-1930. He then joined the faculty at Rensselaer Polytechnic Institute and was chairman of the department of architecture until 1953, when he became an associate of S. J. Kessler and Sons in New York City. He was a Fellow of both A.S.C.E. and the A.I.A. and former chairman of

the board of review for the National Council of Architectural Registration Boards.

The Boston Penguins gathered for blubber Saturday noon January 28 in Brookline. Led by Barbs and **Frank Shaw**, class president, the following chewed the fat and had a whale of a time: Ethel and **Gordon Joyce**, Hazel and **George Glennie**, Ruth and **Bill Giddon**, Helen and **Irwin Sizer**, Nellie and **Hoyt Hottel**, **Herb Stewart**, **Don Moore**, **Ted Burkholder** and **Russ Ambach**. Opinions were sought about making Salem, Mass., our 55th headquarters. It was proposed that we domicile in the Hawthorne Inn in the midst of the Sons of Witches.

George Knight indicates that he and Edith expect to return from England to Peterborough, N.H., about mid-May. England has been colder than usual and has had three separate one-inch snowfalls. He gloats over missing the Boston Blizzard in February. . . . **Gene Quirin** writes, "We like our new home in Vero Beach, Florida." Since the letter was dated January 10, 1978, we wonder whether the cold Florida winter has changed his mind. . . . **Ed Moll** confirms his attendance at the Class of 1924 Florida Fiesta on January 29. Says he went, "to drum up support for our 55th Reunion next year." He and President **Frank Shaw** have occasional telephone conversations on the same subject. . . . **Dick Lassiter**, Class Agent, writes that a Greek named Angina Pectoris caught up with him at Thanksgiving and put him in coronary care until December 7, 1977. Now he faithfully takes his medication and thinks that his progress is good. . . . On March 12, **Herb Stewart** attended the annual meeting of the Fellows of the Institute of Electric and Electronic Engineers in Newton, Mass. Each year this world organization elects 125 Fellows from a 180,000 membership and, as seems to be usual, M.I.T. men this year accounted for 9 or 7.2 per cent, a commendable portion. — **Russell W. Ambach**, Secretary, 216 St. Paul St., Brookline, Mass. 02146; **Herbert R. Stewart**, co-secretary, 8 Pilgrim Rd., Waban, Mass. 02168

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These notes are prepared in January after digging out from one of Cape Cod's unusually heavy snowstorms. It provides me the first opportunity to thank the several classmates from whom I received Seasons Greetings this year: **George Blonsky**, **Chink Drew**, **Fred Greer**, **Hal Halliburton**, **Jim Howard**, **Kamy Kametani** and **George Washington**.

An article in the Dedham, Mass., *Daily Transcript* states that **Ed Kussmaul** was honored by the Westwood, Mass., Rotary Club on November 5, 1977 when he was named a Paul Harris Fellow. This elite fellowship, named in memory of the founder of Rotary, is recognized throughout the free world as a pillar of the Rotary International Foundation. The many projects funded by this trust include educational awards, group study exchanges and special grants aimed primarily at furthering international understanding. Ed joined the Westwood Rotary in March, 1961 and served as president in 1964-65. He has served as chairman of the Rotary Red Cross Bloodmobile for the past ten years, and as United Way Chairman in 1976 and again in 1977. Ed served the Town of Westwood for two three-year terms on the School Committee and was its chairman for part of that period. The newspaper article carried an excellent photograph of Ed and his wife Adele.

George Blonsky, known to many of you as the Count, reports that he is still creaking but not too loudly. His principal occupation is "battling the jackals in white jackets who always need operations, while their patients only sometimes do." He tells about his book entitled *From Beast to Man and Beyond* which so far classifies as a very good rejection slip collector. George notes that his book deals with matters similar to those covered by Bronowsky's *The Ascent of Man* but covers much more ground through extrapolation into regions before and after Man and also into fields of religion, philosophy and science.

Karl VanTassel is to be congratulated for he was one of 16 M.I.T. alumni who received Corpo-

Searching for Unity in the Diversity of Science

For 15 years and more, Harold H. Belcher, '25, has been pondering: is there some fundamental unit or bridge through which the countless concepts of science — ranging from infinitely large to almost infinitely small — physics, chemistry, mathematics, cosmology, can be unified?

There is.

It is the Resonant Energy Medium (REM) or matrix of the universe, Mr. Belcher postulates in *Subnuclear Resonance: Science Unification Key* (Hicksville, New York: Exposition Press, 1977, \$14.50).

Mr. Belcher begins his argument by setting forth the interdependency of everything in the universe: "It would seem that throughout the universe there must exist a communication system so vast and so sensitive," he writes, "that every atom of the universe is in communication with every other atom." The medium of this communication, the REM, is all-pervasive — "in space, within the molecular structure of matter, and within the smallest crevice or passage in the atomic and subatomic structure of matter."

If the REM transmits energy in the form of light, heat, radio waves, etc., it must be vibratory in character — "a medium in which vibratory systems thrive." It must also be perfectly elastic; "we cannot confine or compress it; we cannot cause it to flow from one place to another; we cannot alter its form in any way." In other words, "a perfectly resonant particle."

In his new book Mr. Belcher considers this fundamental concept in relation to 15 areas of physical science, postulating geometric mechanisms to explain natural phenomena — atomic and nuclear structure, electronics, stellar structures and processes, solar and planetary evolution. Mr. Belcher's purpose in writing his work is to encourage experts in each field to weigh carefully the merits of his hypothesis — and, if possible, extend it to new fields.

rate Leadership Awards at a luncheon of the Chicago Club on December 16, 1977. These awards include a silver bowl inscribed with each awardee's name and company and the words, "For Distinguished Corporate Leadership." Karl, as most of you know, is President, Chief Executive Officer and Director of A. B. Dick Co. in Chicago.

A note from **Ken Lucas** indicates he is still most active as Director of the Eastern Massachusetts Association of Land Surveyors School of Survey. This is a correspondence school for continuing education for surveyors. He has seven teachers associated with him and has a present enrollment of about 150 students from all over the United States.

Word from **Fred Greer** mentions that he and Eleanor celebrated their 52nd wedding anniversary last July. Although, like most of us, they are slowing down, they still enjoy life.

Milt Salzman reports he is still involved in many activities, not the least of which is Barbershop Harmony choral singing. He is the Community Service Chairman of his chapter and finds there are many demands for performances at various functions. They are now rehearsing for two shows for the coming year. Milt thinks he may have picked the wrong profession and should have chosen show business.

Belatedly we have received word of the passing of two classmates. Dr. **Jane M. Dewey** died on September 19, 1976 in Key West, Fla., and Dr. **Alexander W. Makepeace** died in San Francisco, Calif., on September 9, 1976.

The passing of **Norman Mansfield** was mentioned in the January notes. A recent letter from his widow provides some information which classmates will appreciate having. Norman attended Phillips Andover before coming to M.I.T. where he registered in Course VI and received his degree in electrical engineering. He worked for three years as a cadet with the New Jersey Public Service Electric and Gas Co. Next he became a member of the Bond Department of the Prudential Insurance Co. of America where he remained for 30 years. After retirement he became Vice President and Member of the Board of Steadman Fiduciary Funds in Washington, D.C. He served on the U.S. War Board Department during World War II and was cited for his service.

Norman died very suddenly of a rapid acting cancer cell. He was wintering in Sarasota, Fla., as he has for over ten years and had played golf only a month before his death. He is survived by his wife, Phoebe Lamont, two daughters (all three Wellesley graduates) and five grandchildren.

Henry Sachs sends me his annual report which reads as follows: "For the last few years I have been slightly involved in the cultural arts program at Tech. Another link goes back to my extracurricular activities, when I was president of the M.I.T. Chapter of the American Ordnance Association. To this day I am an officer of the New York Chapter of the American Defense Preparedness Association, its successor.

"Again I've been on the road quite a bit. After spending a few days in Vermont for the fall leaves and visiting New Orleans where Bee was involved in the American Hospital Association's meeting, we spent Thanksgiving with her folks in Boca Raton, Fla. December was most exciting when we were part of Pan Am's Inaugural Trip to Mainland China. We visited Kwang Chow, Hang Chow, Shanghai and Peking and saw the progress they have been making since disposing of the 'Gang of Four.' It was a most strenuous trip, but oh so worth while.

"We went to Mexico over New Year's and have just returned from an Alumni Flights Abroad tour of Egypt. It was 17 years since I was last there and I found a few changes. One thing is for sure, one should not attempt to visit it on one's own and expect any reservations to be honored. China, Mexico and Egypt all present health challenges and fortunately neither Mao, Montezuma or the Pharaohs took any revenge on us.

"I'll be off to New Orleans for a board meeting of the National Council for Homemaker Home Health Aid Services in a couple of weeks and then expect to stay put for a while."

Harold Belcher, one of our Course II class-

mates who now resides in Orange, Mass., is the author of a book entitled *Subnuclear Resonance: Science Unification Key, Old Data — New Concepts*, published by Exposition Press of Hicksville, N.Y. The flap of the cover states that "this book deals with the physical sciences — from the infinitely small scale of nuclear structure to the infinitely large scale of galactic cosmology.

"A quick scan across the many fields in this enormous range shows only an indistinct trail, full of gaps, uncertainties and conflicts. Each field has its own generally accepted and reasonably productive concepts leading to satisfying or, at times, even spectacular accomplishments. Yet, to a disturbingly large extent, each field remains an island, with only the sketchiest of speculative connections between islands.

"This book is the author's development of a single basic new concept and its application to explain phenomena in all branches of physical science. The basic new concept — that the fundamental particle of all nature is an energy focus of unique diameter d emitting spherical waves of wavelength $2d$ — allows a subnuclear resonance between every particle and the wave fields from all other particles. These resonance relationships define the forces and structures encountered in all physical science fields, from nuclear structure to cosmology."

Despite the title, the publisher notes that this is not heavy reading nor does it involve complex higher mathematics. It is an exercise in common sense and logic. During his professional career Harold has been granted a number of patents. He has been a designer, a design supervisor and administrator in research and development for companies serving the textile and chemical industries. — **F. Leroy (Doc) Foster**, Secretary, 35 Woodland Way, P.O. Box 331, North Chatham, Mass. 02650

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We are here at the Fo'c'stle, our little guest house with one bedroom which according to **Dave Shepard** is two meters high — (his head just touches the ceiling). The electric heat makes it comfortable and a driftwood fire on the hearth makes it cheery. And there is plenty of driftwood around town these days. This is the 29th year we have been weaving Pigeon Cove into our class notes so you know the place. This month the entire fabric will be Pigeon Cove — and Rockport, of which we are the North Village with our own post office.

Every Monday morning, except in the summer, the good ladies of the Universalist church put on a coffee break and vie with each other to supply their best muffins or combine to produce fried dough with maple syrup. (Kitty and **Mal Hird** often attend these coffees too.) With Sunday night storm warnings there was some question about coffee break on February 6. Upon arising Monday the snow had not started and predictions pushed it off until afternoon. The wind from the northeast, however, was strong and the sea gulls put on a spectacular performance that we watched from the breakfast table with enthusiasm.

It was a glider show such as one never sees unless the wind conditions are exactly right, as they were this Monday morning. The gulls came from their island retreat offshore, as they do each morning, but when they arrived over our house they simply stopped and let the high wind flow past their wings and support them with scarcely a motion of their bodies, obviously enjoying their unusual feat. But every few minutes a gull would side-slip to the left and travel like a bullet sideways — having more fun. This entertainment lasted all through breakfast. The coffee break was on schedule later in the morning and so was the storm by late afternoon. The roar of the sea increased and it seemed logical to retire. Somehow this roar lulls one to sleep although it is equivalent to a freight train passing by the window all night long.

Being 28 feet above sea level we were not apprehensive until the top of a 30-ft. wave flew off and smacked the bedroom window with the equi-



How the sea made a cave under George Warren Smith's front yard. For many years, Mr. Smith, Secretary of the Class of 1926, has delighted his classmates — and many other Review readers — with warm and colorful accounts of life by the sea at

valent of 30 buckets of water thrown from a jet plane. The thought that disturbed was, "Just how strong are these thermopane windows?" But we made it through the night and awakened to the ever increasing roar of the sea toward an 11 a.m. high tide. Our 85-year-old neighbor called and said that her living room window had blown in. (It too was thermopane.) The police wanted to evacuate her but she resisted, so we talked a couple of husky firemen into moving the antiques, paintings, and works of art into other parts of the house and battened my boat cover over the entrance to the room just as another window blew in. Then back home to wait for peak tide at 11 a.m.

The wet snow stuck to the sliding glass doors but slid down a little allowing a view of 30-ft. waves roaring towards us. During a wild northeast storm six years ago, we had a similar view and in the spring discovered a ten-ft. square hole at the bottom of our 65-year-old retaining wall. This storm was much worse and from our front row seat it was a bit unnerving to see these enormous waves defying us. But the lawn and bushes remained in spite of winds gusting over 60 mph. It was 24 hours before it was safe to take a look at the retaining wall and the picture was unbelievable. The top three layers of a 42-ft. wall 25 ft. high was all that remained — held by a little mortar and frozen earth.

When spring arrives and the ground thaws, the rest of the wall, the bushes and a major part of the front lawn will crash into the sea. (It has happened since I started to write.) The replacement estimate is astronomical but fortunately the house is on ledge and was undamaged and there is ledge between us and the wall so we hope to replace it with a lower reinforced concrete wall pinned to the ledge and closer to the house.

But we were lucky! A retired coast guardsman

Pigeon Cove on Cape Ann, 40 miles north of Boston. This month he has provided an astonishing account of the "100-year" storm of February 6 and 7, 1978, including the destruction of the Smiths' 65-year-old sea wall.

about a quarter of a mile away had his house split in two and then battered to kindling by 500- to 1,000-pound rocks from a "protective" breakwater, the rocks were carried by the waves as though they were empty wood boxes. The New England Lobster Co. with all of its tanks, pumps, and freezers, simply disappeared from its protective cover of a 20-ft. granite wall. Nothing remains. My barber had a small rental cottage behind his shop on Main Street that was going to be his retirement income. The concrete block foundation only remains. Our local foreign car expert had a new Mercedes diesel up on the lift a few days after the storm picking seaweed out of it — the top of the car was full of dents because each wave would toss the car against the ceiling of its garage with a bang. And so it goes all along the shore line but not a single loss of life or even an injury due to an alert and hardworking police and fire department. The most painted building in America, a fish shack called Motif #1, was destroyed and as a symbol of determination the townspeople are raising funds to replace it with an authentic replica that will include some of the old boards that were driven ashore. Our visitors will never know but the townspeople will view it with pride.

Often in these notes we have referred to Heather, our beautiful collie dog. This will be the last time because last night Heather died of a heart attack. She came to live with us as a tiny pup shortly after our 45th Reunion almost 12 years ago and was usually lying at my feet as I wrote the notes, but not tonight. I never expected to devote an entire column to Pigeon Cove but since all of our readers have come to expect some word about the place I wanted you to know that we are still here and waiting enthusiastically for the sailing season. Cheerio until then. — **George Warren Smith**, Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

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It's the Ides of March, and I'm just back from ten days in the hospital with a nasty staph infection, and still rather shaky. Up to now, I've led a charmed life — I always thought illness was something that happened to people who didn't take care of themselves — and the good Lord apparently decided to teach me a lesson in humility.

The reunion photos have been distributed, and judging by a number of letters I've received, they came out very well. . . . Commenting on how much he and his wife Phyl enjoyed the reunion, **Al Hall** mentioned that they had tickets to hear Arthur Fiedler and the Pops Orchestra in Columbus, Ohio, on March 18.

We've been able to convert a few of the "missing" classmates to those with known addresses, and we're still hunting. Among those who have helpfully sent corrections or additions to the list of names are **Percy Richardson**, **Al Hall**, **Art Connell**, **Tom Scott**, and **Ed Chase**. Here are a few more; if you know where any of these people can be reached, please let me know: **Leo L. Michuda, Jr.**; **Gjon Mili**; **Joseph B. Nichols**; **Edwin A. Norris**; **Leon M. Ogilvie**; **Sergio T. Ortiz**; **Benedicto B. Padilla**; **David C. Powell**; **Edward J. Pratt**; and **Toshio Sasaki**. — **Joseph H. Melhado**, Secretary 24 Rodney Rd., Scarsdale, N.Y. 10583

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Many of your classmates should be now on their way to Cambridge to celebrate our great 50th Reunion on campus at M.I.T. June 6 to 11. They will be coming from all parts of the United States and a good number from other countries. Among the latter we know of **Ana** and **Mariano Contreras** along with **Helen** and **Gabe Disario** from Venezuela, **Shikao Ikehara** from Japan, **Concepcion** and **Pete Moyano** with **Nella** and **Leonardo Siller** from Mexico, **Pam** and **Rene Simard** with **Phyllis** and **Chuck Carter** from Canada, **John Houpis** from Greece, and **Hector Hagedorn** from Spain. We expect the total attendance will be well over 200.

Rudy Slayter became a casualty of the Northeast winter storms when he slipped on some ice and landed on his back. No bones were broken but muscle damage was enough to put him in the hospital for a couple of weeks. . . . **Alice** and **Vic Decorte** plan to drive from Fort Lauderdale to spend a few days on Cape Cod just prior to the reunion. At the end of June they will fly to Europe for a two-month stay in Belgium and France. . . . **Gerry MacGillivray** celebrated his birthday on February 22. At 74 he was still thinking of golf. **Gerry** plans to be at the 50th and looks forward to seeing everybody.

Al Daytz has written, telling us that despite some serious surgery within the past year he is in good active condition and plans to be on campus with **Ruth** in June. . . . **Mary** and **Max Marshall** had a busy year. Although having a few age-related physical problems, they are both active, have traveled a lot, visited friends and relatives around the country, have continued to do some fishing and look forward to the 50th. . . . **George Chatfield** is in the process of selling his two radio stations, **WFGL (AM)** and **WFMP (FM)**, in Fitchburg, Mass., but plans to keep his newspaper publishing business. . . . We had brief year-end notes from **Anne** and **George Palo**, **Rose** and **Maury Beren** and from **Fritz Rutherford**. **Fritz** was planning to visit Russia on the M.I.T. Quarter Century Club Tour.

On page 93 of the December, 1977, issue of *Chemical Engineering Progress* is an excellent photograph of **Jim Donovan** as he participated in an A. I. Ch. E. — Engineering Foundation conference at Asilomar, Pacific Grove, Calif. Apart from the conference, the location was of very special interest to **Jim** since Pacific Grove is where his grandfather settled after sailing before the mast from Australia to San Francisco.

News panels from Alumni Fund return envelopes have provided the following bits. From **George Bernat**: "Have only been trying to invest wisely enough to keep up with inflation, but it

seems to be a losing battle." . . . **Alexander Fowler** says that local history and historic preservation now occupy most of his time. . . . **Bob Kales** writes that for the past ten years he has been Chairman of the Board of Whitehead and Kales Co., building auto carrying cars for railroads and in structural steel but recently sold his interest in the company. He is still president of Kales-Kramer Co., Inc., Jefferson Terminal Warehouse Co. and Midwest Underwriters. He also serves as a director and member of the investment committee of an insurance company. . . .

James Rae says: "Living in peaceful retirement on the shore at Sea Girt, N.J." . . . From **Frank Sweeney**: "Just rolling along — doing a little consulting work, golf, bowling and partying." . . . **Allan Tarr** tells us that he is busy as chairman for the M.I.T. Alumni Drive for Virginia and West Virginia, President of Tarr Security Services, educational representative for Bristol Commercial College (Bristol, Tenn.), Notary Public at Large, Virginia, and a real estate appraiser. . . . And from **Jim Tully** in Fryeburg, Maine: "Sue and I had a very enjoyable trip to Copenhagen at the instigation of the M.I.T. Quarter Century Club in October."

For **Peggy and George Mangurian** the highlight last year was a three-week trip to Russia. They enjoyed it all — especially Moscow and Leningrad (with its Hermitage Museum). A most interesting part was their nine-day stay in Armenia, which became a part of Russia in 1920. They stayed in Yerevan, the 2,056-year-old capitol of Armenia, enjoying tours every day and concerts at night. Since George could speak the language it added that much more to the fun and excitement of their visit.

Walter Norton writes that he has been in retirement since 1967 and is now president of the Lithuanian Philatelic Society of New York and editor of its *Quarterly Journal*. . . . **Harold Geiger** sums up his news in two words: "Pleasantly retired". . . . **Mary and Max Parshall** plan to fly in from Montana two days prior to the reunion and visit with Janet and **Fred Lewis**. . . . **Myron Helme** says he has outgrown his 1928 tux by many pounds and hopes he will not need it at M.I.T. in June. . . . **Allan Tarr** lives in Marion, Va., near Mt. Rogers. This mountain was named for M.I.T.'s first president, William Barton Rogers, and Allan believes that a plaque should be installed at the site to show connection with the Institute. . . . **Jim Donovan** has done a tremendous job in developing the Class Gift. This five-year effort is now approaching the finish line. Contributions are still coming in and Jim would be most pleased to hear from any of you who still intend to make a pledge or might wish to report plans for a bequest. Presentation of the Class Gift will be made at the Technology Day luncheon on Friday, June 9.

The following warm and friendly letter was sent us from Chris Santos, daughter of our deceased classmate: "**Tirso N. Santos, Jr.** received his B.S. from the University of the Philippines in Civil Engineering; however, the 'tute was just as dear to him if not more so. From the time he received his Brass Rat until the day of his death, he faithfully wore his ring. Upon receiving his master's at M.I.T., my dad worked in the engineering profession in New York and Washington, D.C., moving to Cambridge in 1950 when he married my mother. Dad was then manager of the structural branch of the First Naval District and maintained that post until his retirement at the dissolution of the District in 1970. The retirement stemmed also from a stroke which left him paralyzed on the right side. My mother, Remedios Cenizal-Santos, M.D., resigned her post with Blue Cross-Blue Shield in Boston in order to care for Dad until his death seven years later. She is now a Peace Corps Physician in the Philippines but we still maintain a link with M.I.T. I spent my senior year as a special student at M.I.T. and worked for a year on the staff at *Technology Review*. My husband is Chris Dippel, '75, and my cousin, Maria Olivia Cenizal, is now a graduate student in the Sloan School."

We regret to report that **John E. Ward** (Course I) died on January 11, 1978 following a brief illness. Hap was a civil engineer and materials control engineer for the State of Massachusetts until

his retirement after 43 years of service. He was a member of various professional groups including the American Association of State Highway Officials from which he had received an award for meritorious work in highway construction. To his wife Lillian and their family we extend our heartfelt sympathy. — **Walter J. Smith**, Secretary, 37 Dix St., Winchester, Mass. 01890

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Warren Walker celebrated his 70th birthday on January 15 during the season's Big Freeze. After 35 years with his company (Metal Graphite) he has no thought of retirement, though he has a fine team of executives backing him up, headed by his son-in-law John Michelson, as vice-president of manufacturing. Warren finds time to dabble in politics and he is making good headway with the American Association of Industrial Management with the help of a retired air-force general. . . . **Neil C. Ross** has retired for the second time and has happily remarried since his first wife, Alice, passed away. They had been married for 48 years. "We are now living in Santa Cruz, Calif.," he continues, "and I don't seem to find enough time to do the things that I want to do."

H. Dayton Wilde, having retired from Exxon, is enjoying a leisurely life with his wife, Louise, in Houston, Tex. Last fall, he was named a Fellow of American Institute of Chemical Engineers. Louise and he have three children and 11 grandchildren.

Thomas W. McCue is still engaged in various business enterprises connected with sales of steel and metals, acting as manufacturers' representative. He is also taking courses at Boston University.

Barbara and George Meyers' 1977 Christmas calendar was full of activities, some joyful and some sad. They attended a wedding of their nephew, Barry Davidson, in the beautiful mountains of Virginia: George and Barbara also attended an interesting and inspirational Southeast Episcopal Conference on Renewal at St. Simon's Island, Georgia. George is Senior Warden of Christ Church and teaches Sunday School, while Barbara is a member of the Diocesan Council, the Alter Build, and the Board of Christ Church Episcopal Church Women. George lost a cousin (Ruth Bowie) and Barbara lost a brother (Bert Houghton). On Labor Day, they had a delightful experience baby-sitting for three of their grandchildren, ranging from 6 weeks to 4 years old, for ten days. Like all grandparents, one feels that they must have had thrilling experience followed by great relief. George is now semi-retired, does some consulting work, and helps Barbara in her real-estate work. They are well, play tennis several times a week, and take a mile hike on non-tennis playing days.

Frank Mead and wife Mary have now adopted Northport, Fla., as their second home, after having spent several winters there. They are on the golf course almost every day and are active in M.I.T. Alumni affairs. They recently joined the Southwestern Chapter of the M.I.T. Alumni Association. Dr. Paul Gray was the main speaker at one of the meetings, which was attended by about 60 alumni and their wives. Among those attending was Chet Buckley, '26, who wanted to be remembered to his fraternity brothers: **John Wilson, Jim Fahey, Paul Donahue** and Art Connell, '27.

Henry F. Robbins announces his marriage to Anne M. Wedlock last December. She is a supervisor of Transmission and Network Services of A.T. & T. in Basking Ridge, N.J. . . . **Richard T. Hoffman** says that those of our classmates who haven't tried retirement yet just aren't in the "IN" group. . . . **Franklyn J. Lammers** went to a Fluid Power Exhibition in Tokyo, Japan, last fall with his wife Virginia. Besides touring Japan, they took the opportunity to visit a few other countries which included Thailand, Bali, Singapore, Hong Kong and Borneo. His firm represents and distributes equipment manufactured by "Parker-Hannifin." He is presently working on hydraulic systems for Manila and India. His company also gives special courses in hydraulic systems to local industrial personnel.

Donald L. Hibbard writes, "Sorry I did not get a chance to see you last summer while we were in New Hampshire. We spent a month in Switzerland last summer. I am struggling to make an electric car out of an old Fiat, and I find that I took the wrong course at M.I.T. I hope something constructive will develop from it. Regards to all." . . . **C. Fayette Taylor**, Professor Emeritus (M.I.T.) in the Department of Mechanical Engineering, has been honored by the Society of Automotive Engineers through election as an S.A.E. Fellow. Professor Taylor established the Sloan Automotive Laboratory at M.I.T. in 1926 where he pioneered basic research on the internal combustion engine, theory and design.

Larry R. Moses writes, "Our 45th wedding anniversary year was highlighted by the wedding of our daughter, Kathy, to David A. Bianchi on February 26. It was held here in Sarasota, followed by a large reception at the Long Boat Key Golf Tennis Club. In September, we toured Scandinavia with a couple new and dear to us. From there, we went to Heidelberg by train to spend a long week-end with our oldest son, Larry, who was promoted to Colonel U.S. Army, and is now Deputy Commander, 56th F.A. Brigade in Southern Germany. Another couple joined us in Heidelberg, and we toured Switzerland, Italy, Yugoslavia and Austria. Two week-long visits with Kathy and David in August and November, rounded up our travels. They spent two weeks with us here at Sarasota, which included Christmas and New Year." . . . **Bill Aldrich** writes, "I stopped having birthdays some time ago, though I appreciate being remembered. Birthdays are taken over by our children and grandchildren. I still keep working to keep myself busy. I have cut down outside community activities in favor of the family. We are still talking about the wonderful time we had at our mini-reunion here in Billings, which was a forerunner of our 50th Reunion. Those classmates who attended, generated lot of interest for our Big Reunion which is on the horizon. Best regards to all and many thanks for your class notes."

I regret to announce the death of **Isadore Winer** (Glenn Falls, N.Y.) on February 7, 1978.

A note from **Ed Roche** says, "Greetings from the snow capital of upper New York state which is known as the Wonderland of the Niagara frontier. We have had 60 inches of snow so far (December) with more to follow. I am sure. The cold Canadian winds blowing across our Great Lakes, creates unpredictable effects — snow storms and squalls — until Lake Erie freezes over." . . . **Jim Fahey** and wife "Teddie" are spending their winter vacation here in Southern Florida. They paid a short visit and discussed our forthcoming 50th Reunion. We plan to see them this week along with **Bob Pride** and his wife Marion. — **Karnig S. Dinjian**, Secretary, 10 Ancient H'way-Plaice Cove, Hampton, N.H. 03842; (603) 926-5363

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The usual vernal spat of news items has apparently now peaked out and as in prior years, I plan to hoard a few items for next month. If you have sent in a report and do not find it referred to herein, please be patient.

In May the Audio-Engineering Society held its 57th International Convention and as a part of the proceedings celebrated 100 years of sound recording. Chairman **Bob Rypinski** reports that it was an outstanding success. Bob sends best wishes to all friends and is looking forward to seeing them in 1980.

Hank Bates reports that he and Helen met Eleanor and **Frank Nettleton** by surprise in a hotel lobby in Caracas, Venezuela, last November. The Nettletons were on a Caribbean cruise from New York and the Bates were on a cruise from Puerto Rico to Los Angeles.

Harold Bethel retired in 1972 from his job as Senior Civil Engineer in the Transportation Department of the N.Y. State Department of Public Works after 45 years of service. He has apparently continued to live in Albany since his retirement. . . . As previously reported in the

Notes, **Palmer Boggs** partially retired in 1973 as Professor of Architecture at the University of Arkansas but continued part-time teaching. He now reports that he has completely retired from teaching but is still doing a limited amount of consulting work in structural engineering.

Dave Landen has retired from his job as Research Civil Engineer in the Office of Research and Technical Standards, U.S. Geological Survey. He worked for the Geological Survey for over 42 years in various phases of topographic mapping. He also lectured part-time at George Washington University on geodetic and cartographic science. Apparently he has continued the part-time teaching at George Washington where he is presently Associate Professorial Lecturer at the College of General Studies. . . . **Ed Pritchard** retired to Cape Cod last November, but doesn't say what he retired from. According to some information I have that is almost ten years old, he was at that time working on Project Mallard, a long range tactical communications system for the Department of Defense. His son is a Professor at M.I.T. whose doctorate in physics is from Harvard and M.I.T. Ed reports that he is in good health and finds "hundreds of things to do" to keep him busy.

As previously reported in the Notes, **Amerst Ed Huse** retired in 1971 as Special Advisor on Public Utilities of the Division of Corporate Regulation of the U.S. Securities and Exchange Commission in Washington. For the last ten years he has served as Treasurer of the National Association of Watch and Clock Collectors, Inc., of Columbia, Penn., a non-profit educational and scientific organization with 32,000 members. He collects and researches the history of antique American clocks and has lectured extensively on this subject. Ed reports that he is "delightfully healthy and grouzier than ever." His prescription for a happy retirement is: "have grandchildren and keep busy. If you are willing to work for free, you will never suffer the pains of unemployment, but you may find yourself in a situation similar to that of Ado Annie in *Oklahoma*: I'm just a guy who can't say no!"

Regretfully we now have at hand reports of the deaths of two more of our classmates: **Charles Lutz**, who died last May, and **John Molloy**, who died on January 2, this year. My information about Charles is sketchy. It appears that he worked for a time for United Aircraft and thereafter for Lockheed in Van Nuys, Calif. He was living in La Crescenta, Calif., at the time of his death. John was a retired Vice President and General Manager of the Cambridge Electric Co., from which he retired in 1976, after serving 46 years. He was a member of the Massachusetts Society of Professional Engineers and also a Director of New England Gas and Electric Association. He is survived by his wife Nora, a son John, Jr., and a daughter Kathleen. — **Gordon K. Lister**, Secretary, 530 Fifth Ave., New York, N.Y. 10036

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About ten days ago, these would have been about the happiest notes that I have ever written. Sally and I became proud grandparents when our daughter, Babbie, presented us with a baby girl, Heather Elizabeth Ricard, our first grandchild. I am pleased to say that monther and baby — yes, even father — are doing well. My feelings took an about-face early Friday morning, March 3, when my beloved wife, Sally Reynolds Worden, suddenly passed away. Everyone has been so thoughtful and considerate but I don't believe I'll ever recover from the shock. Sally was in the class of 1929 at Wellesley, always most active in the college affairs, President of the Women's Bond Club in New York, President of Zonta, well known for the work she did for Grace Church in Brooklyn Heights, and gave me five of the happiest years in my life. Memorial services were held in Tangerine Community Church and at the Grace Church in Brooklyn Heights on March 13.

A recent note from the Alumni Association mentions that **Lou Evans** was in Indonesia for Mobil-Pertamina Oil Co. No further details were

received. . . . Hope and **Randy Binner** have no plans to move from Connecticut although he mentions that the 10° temperature on the morning he wrote his letter makes Florida sound pretty good. Randy is still consulting with Great Lakes Carbon one or more days a week, adding that it keeps him in touch with his associates of over 25 years and feels that he is still doing something constructive. He also asked for more details concerning the proposed mini-reunion.

. . . A Christmas note from the **Jack Lanes** reports that Jack gets to Paris usually in April for C.F.R. but that Bert was not able to go with him in 1976 or 1977. However, they did have some great trips together, visiting San Diego, Montreal and Boston, as well as Cape Cod. At the Annual S.A.E. Technical Board Luncheon held in Detroit, Michigan on March 3, 1977, Jack was awarded the S.A.E. Certificate of Appreciation for his exceptionally outstanding services in the Society's Cooperative Engineering Program. Congratulations, Jack.

A number of letters have been written to classmates from whom we haven't heard for some time, but to date, **Skeets Dean** has sent the only reply. Will keep up these efforts in the hope that others will follow Skeets' lead.

News of other classmates is slim this month. Word comes from **William Nixon** via the Alumni Association telling that in May, 1977, he was elected President of Perquimans County Restoration Association which is restoring the oldest house in North Carolina, circa 1685, near Hertford, N.C. . . . From **Polly Germeshausen**: "Plans are already under way for our mini-reunion in Bermuda in the spring of 1979. We had to give up Puerto Rico. Further information should be going out to you in July." — **Edwin S. Worden**, Secretary, P.O. Box 1241, Mount Dora, Fla. 32757; Assistant Secretaries: **Ben Steverman**, 260 Morrison Dr., Pittsburgh, Penn. 15216; and **John R. Swanton**, 27 George St., Newton, Mass. 02158

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Jack Kelman recently had a visit from **Kurt Heinicke** and his wife Lynne. Kurt and Jack went to work for Leitz in 1932. After a few years Kurt started his own business, Heinicke Instrument Co. Now, having sold the business, he has retired to a large farm in Glenville, N.C. Taking care of the farm is Kurt's main exercise. It must agree with him because he looks great.

We have received some news about **Adolph Feibel** of Hamilton, Ohio. He retired in 1976 from the Spartan Glove Co., a company he started many years ago. He was and still is active in many civic activities. He was president of the National Industrial Glove Distributors Association, was recently appointed to the Board of Overseers of the Hebrew Union College, and currently is head of the Greater Cincinnati Cancer Center. His wife, Ruth Clair, and their two sons and five grandchildren help keep Adolph busy.

Since the mail bag is light this month maybe a bit about myself will not be amiss. Our company, Lloyd Laboratories, Inc., was started in 1939, but did not really get going until after the war in 1945. We mainly serviced the leather industry with specialized finishing materials. There was slow and modest growth over the years. In 1974 our company and our industry were hit with a triple whammy — imports, synthetic leather, and a recession. Many companies folded. We survived by combining our operations with three of our troubled competitors, and last year we added another company to our family. We are really a decentralized organization with a large area of policy and pricing left to each segment. Since we needed financing for all this expansion, rather than lean too heavily on banks, we have allowed anyone to make short-term renewable loans to Lloyd Laboratories for 1 per cent above prime. So far the sum is greater than its parts. Incidentally, ten out of 30 personnel are in their 60s or 70s, and at the moment my own retirement does not seem imminent.

Privately, Ruth and I are in our second marriage for nine years. We share the trails and pro-

gress of six children — the first has just been married and the second will be married this June. We realize that time is not unlimited, and we participate in as many aspects of life as we can.

Please keep writing so I can make this monthly column as newsy as possible. — **Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, Mass. 01907

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We have quite a few Alumni Fund capsules which could not make the March-April capsule, and they are worth waiting for, as always. **Allan A. Hinkle** says that he has been retired for three years (now he tells me) and has spent about all the time since then travelling. Earlier he and Fay visited 20 countries and last year six more in Central and South America. As a diversion, they vacationed in Florida, Hot Springs, Ark., and Gatlinburg. They will attend the 45th.

Help! We have a capsule from **Sam Lieben**, an old correspondent, but I cannot read it; only that he's a director of two companies, probably in New Jersey. Sam is otherwise retired. . . . **Norm Spoford**, only recently of Pensacola, is retired to travelling and chores around the house and is spending a lot of time with a group of Vietnamese refugees who are learning English and American ways. . . . **Eugene Rohman** is retired from United Technologies, and living on Cape Cod. Gene and Marjorie do a little golfing but more travelling — in Europe and the Mideast; he does some consulting when leisure activities leave time enough.

George Hughes writes that he retired from the Army as Colonel in 1966, then taught mathematics at the Air Academy Junior High School, and is now retired from that career. They do some travelling, but more time is spent repairing and maintaining his wife's foreign and domestic clock collection. They visit their daughter, who lives in Oklahoma, when time is available. . . . **Bob Olsen** writes that he works with the University of Florida's Agricultural Research Station directly with migrant workers in an effort to improve them and raise their scale of living. The Olsens are members of the Church of the Brethren as volunteers. . . . **Forrest P. Dexter** writes that he has just finished one and one-half years as Staff Director of the Citizens Dickey-Lincoln Project Impact Review Committee, visiting with people from all walks of life and working with state and federal agencies.

An interesting bit from **Bob Wellwood**, concerning his travels countrywide in search of long-lost relatives and visiting with antique car collectors; however, Charleston is still home. . . . The **Prentiss Lobdells** have just returned to Florida from a brief visit to Greece and the Greek Islands. **Jim Turner** is visiting in Florida — on the Gold Coast — and as this is written (March 6) we expect him and Edna to drop in for an eye opener. . . . We have already reported **Morris Cohen** receiving the Medal of Science from President Carter. Now comes an undated dispatch announcing that Morris has been selected to receive the Albert Sauver Achievement Award, American Society for Metals, in recognition of work on the "martensite transformation in steel," with which I am unfamiliar.

We have from **Berj Tashjian** a long message on his talented family. Daughter Charmian is a teaching fellow in the Ph.D. program in music composition at Northwestern; Daughter Bidu is completing curricula at the School of the Art Institute in Chicago; and son, Gene, is a junior at Valparaiso School of Business Administration. We have a large clip from the *Sarasota Herald Tribune*, sent in by **Bill Sheppard**, who is very active in SCORE, counselling future executives. . . . **Dayton H. Clewell** is not really retired; he is a Director of Mobil Oil and was a principal speaker at an American Chemical Society convention at the Broadmoor Hotel, Colorado Springs, to discuss the future of energy sources.

Cal Mohr sends me a letter from **Bob Dillon**, reporting that Bob and Alice took a couple of college credit courses at a local (Texas City) junior college; in the spring they flew to Grand Rapids to the wedding of a niece, then on to New

York to the wedding of a daughter of an old friend. Then they immediately took off for Athens, and boarded one of those cruises visiting the Near East as social and political conditions permitted, and many of the fabulous Greek Islands. Back home, Bob booked into an Astronomy course which inspired him to try to revive a lot of his mathematics and sciences. Bob is Secretary of the Planning Commission of LaMarque, Texas, and Treasurer of the South Texas Section of the American Society for Quality Control; and last fall he was elected Treasurer of the national convention of A.S.Q.C. this year at Houston.

From **George Ropes**: after passing 65, he is busier than ever, teaching mathematics and teaching other teachers how to teach mathematics as mathematics coordinator in two public schools, teaching also in one private school and also in two universities, at the graduate level. The Ropes family is grown and scattered: one married daughter lives in Australia, another in New York, a son is in a Ph.D. program at M.I.T., and another daughter is at Indiana University. George and Cathie are looking forward to a move out of Scarsdale, as their present home is inconvenient for the many, scattered moves that George has to make.

... Another letter from **Paul Genachte** from Madrid: He and Suzanne have decided to settle in Southeast Florida, within easy driving distance from Miami. ... Last but surely not least comes **Beau Whitton**, who is confirmed in at Cahtham Bars Inn come June, so he will break ten years of no-show. Although Beau is retired, he still acts as publicity man, for the southeastern states — still looking for business. Last summer the Whittons visited the Crane Estate in Ipswich and Beau took quite a bit of footage on his 8-mm movie camera; now he asks that someone bring an 8-mm projector, the "old type" and not the Super 8, so we all can see the spot where we spent part of our 25th. So, if someone writes me that he will bring the projector, Beau will do some entertaining.

A bit bizarre, but I must confess that I just received a card from **Bill Huston**, postmarked some place in Igdia, which I cannot locate in my usual note-writing mess, but we will see Bill in a few months and he can tell his story himself. ... Golly, I almost forgot a phone call from North Miami, and **Harry Summer's** voice; he visiting there on a short vacation. Harry is well and will definitely attend the 45th.

This is a heck of a time to get in a plug for the 45th, but we still might reach another dozen who are on the fence. I don't know **George Stoll's** figures, but if my mail is believable I think our largest group ever will be on deck. So as you read this, I will see y'all in less than a month. — **Warren J. Henderson**, Secretary, Fort Rock Farm, Drawer H, Exeter, N.H. 03833

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This is the month I hope to play "catch-up" with some of the material still on hand when last month's notes were completed. We'll see how far I get.

It's amazing how long you can know someone and not realize what they were doing. During the years I saw **Fred Vaughan** on Long Island I never knew he headed a thriving packaging business of his own. A clipping from a local paper has a big account about his firm, one that he developed from a subsidiary of Joinnell Lithographic Co. that he bought out in 1955. It's just a small operation — last year the output was 10 million boxes! Fred has help; after two years in the Peace Corps, his son Robert is working with him. The work is challenging because, with the design of the packaging, they are involved in marketing as well as plain manufacturing. That the marketing aspect rates high is shown by some of Fred's customers; Revlon, Estee Lauder, and the producers of Scrabble and Parcheesi. The business produces about \$1 million worth of boxes per year, employs 50 to 60 people and recently won a first prize at the 27th annual Rigid Paper Box Competition of the National Paper Box Association.

George "Benny" Fowles included his and Beth's Christmas letter with his Fund notes. Let

me quote from the first, so the latter makes sense. They had taken a round-the-world trip in 1977, beating Jules Verne's time by eight days. It was a great trip, but as usual after a long one, home looked good. They had gone first to Tokyo, then Hong Kong, Bangkok and Singapore. From there they took a boat to Indonesia, then flew to Australia and New Zealand; on to South Africa and came home by way of Brazil and Venezuela. They said, "We've learned to appreciate the good old U.S.A. — wonderful people en route, fabulous hospitality, but it's still best to be home." George adds in his Fund note "I'm still teaching at Georgia Tech in Atlanta and living in Florida in the winter and Highlands, N.C., in the summer. We see a lot of fellow M.I.T. retirees here in Florida in the winter. We met quite a few on our world trip — you find them everywhere."

A note from **Dick Sanders** brought both pleasant and unpleasant news. The latter first — an obituary of **Harry Fine**, who died early in December in the George Washington University Hospital. Harry had joined the Boston Office of the F.C.C. in 1940 and in 1945 he was transferred to Washington. Through the years he specialized in radio-frequency bands and their allocations. As part of this work he was a technical adviser to numerous U.S. delegations to the International Telecommunications Union. He was named Deputy Chief Engineer of the F.C.C. in 1974, a position he held at his death. His technical contributions had been recognized by his election as a Fellow of both I.E.E.E. and the Washington Academy of Sciences, and he was the author of numerous articles on technical subjects. Harry is survived by his wife Thelma, three sons, a brother and sister, and two grandchildren. To all the family I extend the sympathy of his classmates and the regret that we learn of a fine career only when it ended in such an untimely fashion.

For himself, Dick says: "Nothing much new for us except planning a trip to part of Australia and New Zealand for January/February of next year (1978). We are having some itinerary problems due to some stops en route, but even if we can't work everything out, plan to go ahead." Since the trip will be over by the time this is printed — how about something on the highlights, Dick?

A most interesting letter came to me through **George Bull** who still can lay hands on his *Technique* and thus found that the now Rev. **Joseph A. Hahn** was a "commuter" who entered M.I.T. in his junior year. Rev. Hahn, in 1977, celebrated his 35th anniversary as a priest of Maryknoll (the Catholic Foreign Mission Society of America). He had been in Course XVI and says apologetically, "I haven't kept up much contact." Read on and you can understand why not. After graduation, Joe Hahn was a Guggenheim Fellow at the Guggenheim Institute in Akron. After not too long he "changed his life, studied for the priesthood and was ordained seven years later." He taught for three and a half years, then worked in Bolivia for two years and went to China as Associate Professor of Engineering at Lingham University. After the Communist take-over he was able to stay until January, 1951, when he had to leave. Rev. Hahn worked for many years on book publications, then four years in Chile and one in Brazil, and then he was called back to take charge of Maryknoll's computer operation. Then, after four more years, he took over his present work, which is Marketing Director and Production Manager for Orbis Books. Of that job, he writes, "In these past years we went from 3 to 130 titles, producing a new book every two weeks, on the average. Our books are related to the Third World, giving Americans the opportunity of learning how others think about theology and social and economic issues."

Albert M. Talbot sent along a note on his present activities — he is serving as Director of Operations for the International Executive Service Corps in Turkey. He says this is an organization that sends retired volunteers to developing countries to help companies and agencies with production, technical and managerial problems. For those who might be interested, information can be obtained from I.E.S.C., 622 3rd Ave., New York, N.Y. 10017.

In a round-about fashion I received the sad

news of the death of **Frank Brazel** in Darien, Conn., in January of this year. It is a loss I feel personally as Frank and I were friends in school, even though in widely different fields. The news came to me through **George Bull**, to whom it was an even greater loss, as Frank had been an usher at George's wedding and they had kept in touch, seeing each other in fairly recent times. To Frank's widow, Gretchen, I extend the sympathy of the many friends Frank had in the class.

A very touching letter came from **Bill Coleman**, one of the Course VI members with whom I had worked closely the last year of school. Because so many of our classmates knew his wife, the former Louise Sullivan, he asked me to note that she had died of lung cancer in January. Bill had retired from U.S. Steel in 1975 after her illness had been diagnosed in Pittsburgh. They moved to St. Petersburg to give her the advantage of the milder climate. Two sets of radiation treatments helped some, but could not stave off the inevitable. His son also works for U.S. Steel in Pittsburgh and is expecting a second child shortly. Bill will be spending some of the summer with him, but expects to stay in St. Petersburg. However, I know he faces a hard period of adjustment and I'm sure he would welcome hearing from any friends in that part of Florida. His address is 1148 79th St. South, St. Petersburg, Fla. 33707.

Now for some of the Alumni Fund notes. **Walter Hofmann** writes that he retired from active service with Bethlehem Steel Corp. on August 1, 1975; active in boating in the San Francisco Bay and Delta area — U.S. Coast Guard Auxiliary; golfing at Stanford Golf Club, is Treasurer 1978 Caliente Isle Yacht Club on Bethel Island, Calif. He and his wife Edith are enjoying these pleasant California winters and good skiing this season in the High Sierras. ... Very cryptically **Howard Sharp** writes: "Management Consultant." Since his note slipped through uncanceled I can't even tell you where he's operating.

Theodore Steinberg says: "President, American Association of Ophthalmology; wife, Alice, a dietitian; daughter, Marcia, attorney for the Water Resources Board, State of California; son, Joel, doctor — resident in neurosurgery at Baylor University." ... A note from **Ed Asch** was fun to get — I always remember him for two things — we both worked for different divisions of the old Sperry Corp. and by, I think our first reunion, but certainly by the second, his hair was completely gray. He has been abroad and writes: "We recently returned from a short trip to the U.S.S.R. Moscow's subways are everything claimed for them, and more; service tremendous, but trains noisy. Inside the Kremlin surprisingly peaceful and restful atmosphere. In the cities and countryside no litter. Smog is in the bigger cities; traffic jams beginning to show up. Leningrad beautiful and magnificent — excellent food (unlike Moscow). Capitalism, even on a small scale, flourishes; individuals will do the same things we do to pick up an extra ruble. An interesting and fascinating trip."

From more travellers, **David R. Tashjian** notes, "Retired in 1976 — spent six months in England gathering material for a book, now in publication. Am engaged in consulting work." ... Finally, **Ernie Massa** says, "Since retiring in 1970 my wife and I are enjoying our new home in Pompano Beach, Fla.; however, for the summer months we return to our home in Cohasset to enjoy the New England Summers. This past summer we spent two weeks in Paris and Switzerland."

There are still some more to come but I will save them for next time. I'll close with a mention of a clipping about **Paul Wing**, Vice President of Engineering at Masonellian. He had contributed an essay on various types of control valves to the 50th anniversary edition of *Instruments and Control Systems* magazine. Actually now, Paul is beginning to ease off and is enjoying the luxury of a shortened work week. — **Robert M. Franklin**, Secretary, 620 Satucket Rd., (P.O. Box 1147) Brewster, Mass. 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Apt. 711, Chevy Chase, Md. 20015

Wesley H. Loomis III, is the latest '35er to be honored by his industry affiliation. He was recently awarded the Pioneering Spirit Award of the Independent Telephone Pioneer Association. Wes is only the second recipient of the award in the Association's history. The award was made for "outstanding contributions to the telecommunications industry." Wes has been President of the General Telephone Directory Co. since 1956. He is Chairman of the Travelers Aid-International Social Service of America as well as a director of the Metropolitan Chicago Travelers Aid Society. Our Congratulations.

A note arrived from **Gustav Maass** through the Alumni Fund Office: "Our consulting practice has become specialized in telephone system planning. We are having an interesting time with the new generation of stored program, time division switchers." Gustav's wife died in May, 1977, after a prolonged illness.

The date, time, and place have been set as well as the menu and the entertainment. All we need now is for you to send your reservation to **Bernie Nelson**, Box 112, South Harwich, Mass., 02661, with your check for \$10 each to cover the open bar and dinner for our Mini-reunion: Friday, June 9, at M.I.T. in the Mezzanine Lounge of the Student Center, 5:30 p.m. to 8:30 p.m. **Bernie Whitman**, also known as the original master of magic Fu Ling will present a performance of magic for us. If the spur-of-the-moment presentation he gave us last June is any measure, you will not want to miss this. **John Taplin's** committee will report on the 45th Reunion site selection. Make your plans now to include this stop in Boston/Cambridge June 9. If you would like to join in the fun of our Annual Class Golf Tournament, please get in touch with me. This season will be our 18th.

We are sorry to report the death of **Albion R. Fletcher, Sr.** who died suddenly at the Massachusetts General Hospital on February 22. He was long active in town government in Braintree, where he had lived with his family the past 35 years. For the past 12 years he has been with Stone and Webster. His son is Secretary for his M.I.T. Class of 1972. On behalf of the class I am sending our deepest sympathy to his wife Mary and his son and married daughter.

As this is being written, a comparatively warm rain is gradually washing away the 38 inches of snow we received in our front yard in February, through which we were not even allowed, let alone able, to drive for a full week. We all hiked to the local store for food, bearing it home in knapsacks on our backs. It was a period of much good exercise and getting acquainted with neighbors. We lost a week of work but I think now, over a month later we are booking all the orders we were not able to take that week. If this keeps up, and it looks as though it is snow-balling, Theta-J Relays will be a name you will hear often in the electronics industry. We are moving into larger quarters April 1, having moved each year since we started in 1975. Unless things get completely out of hand, I shall see you on the golf course. — **Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

Busy as ever, **Laddie Reday** has been backpacking and hiking in Patagonia and Tierra del Fuego. Meanwhile, back on the home front, he is involved with the construction of a multi-tenant industrial building in Santa Ana, Calif. In between, Laddie writes for the *Los Angeles Times* and assorted magazines. . . . **Wilfred M. ("Wiley") Post, Jr.** has received yet another honor — this time a Service to Mankind Award from the Lehigh Valley Serotoma Club, honoring his involvement in Junior Achievement, the board of the United Fund, the First Presbyterian Church of Allentown, the Kiwanis Club, and other organizations. Wiley continues as manager of the Allentown-Bethlehem-Easton Airport. . . . **Norm Copeland** retired at year end from Du Pont where he was a senior vice presi-

dent. He will continue as a member of the company's board of directors. After graduation, Norm studied at the Swiss Polytechnic Institute in Zurich before joining Du Pont. He earned his M.S. in 1948 and his Ph.D. in 1949 from the University of Delaware. In 1976 he was named Delaware's outstanding engineer.

I regret to report the death on January 19 of architect **John Valtz** in Lynn, Mass., after a lengthy illness. His Malden-based firm, Valtz and Kimberly, designed many schools, churches and other public buildings in Boston and on the North Shore. To his wife, Amelia, '37, daughters Denise and Gail, and son James the class extends sympathy. . . . From **Bill Orrison** in San Antonio I received news of the death on July 12, 1977 of **Clyde F. Cameron** of Victoria, B.C., from the effects of a stroke. Like Bill he was a graduate member of the class, receiving an S.M. in civil engineering. To his wife, Janet, our sympathy. She lives at 3040 Devon Rd., Victoria, B.C., Canada U8R6C9.

About the time you read these notes, your Secretary hopes to be exploring again some of the more remote areas of Canyonlands National Park in Utah. The snowshoeing this winter has been excellent! — **Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, Conn. 06091

Donald S. Duncan has recently retired from Pratt Institute, Brooklyn, N.Y., where he was a professor of physics. . . . **Robert Fowler, Jr.** retired on February 1, 1977, after serving New England Systems for 40 years, most recently as Senior Engineer. Bob is working part time at old Sturbridge Village. . . . **Howard M. Cousins** writes that he and his wife had a very enjoyable trip last fall to New England visiting Boston and the Institute. Howard retired from Lockheed in 1974, but recently spent some time as a consultant in the L1011-500 long-range transport. . . . **Milt Lief** writes that "our son Dr. Laurence H. Lief is now in San Diego on a cardiology fellowship at the University of California Medical Center. He is already a Diplomate in Internal Medicine. Our daughter Anne and her husband David Willis are still in New Orleans where David is working on his Ph.D. thesis in Hospital Administration. Our younger daughter Debbie, husband Leo and our granddaughter Autumn J. are still in St. Louis with us and the baby keeps us young."

It is with sadness that I report the death of **Len Seder's** wife Annette in early March, 1978. Annette helped Len in the class statistics which he presented at our five-year reunions. She was at our 40th-year reunion last June. Our sympathy goes to Len and Annette's family. — **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, Mass. 02155; **Lester Klashman**, Assistant Secretary, 198 Maple St., Malden, Mass. 02148

Dave Wadleigh's plans for the 40th Reunion are practically complete. We'll be guests of the Institute at Burton House from Thursday afternoon, June 8, through Sunday, June 11. The program includes a pre-Pops dinner, the Pops concert Thursday evening, the all-alumni Technology Day followed by a class dinner with a superb MC, a boat cruise and clam bake on an island in Boston Harbor on Saturday, and a farewell brunch on Sunday. If you did not put in your reservation, and you decide that you want to join the several hundred that are reuniting, for goodness' sake get on the telephone and we will find accommodations at Cambridge. After all, you can attend only one 40th Reunion in your lifetime.

Your secretary has just learned that we have a traitor in our midst; the class of 1939 has designated **Don Severence** as a member of 1939 in spirit. Your secretary is writing to find out what this "spirit" is all about as I always considered Don as 1938. . . . One of our classmates finally got recognized for something he did about 20 years ago. **Sid Baron** retired in 1976 from the New London Laboratory of the Naval Underwater Sys-

Proxmire's "Golden Fleece": Conscience or Enemy of Science?

Robert W. Newman, '36, of Stamford, Conn., is locked in combat with the *Stamford Advocate*, and he wants help.

In ridiculing scientific research by taking conclusions out of context in making his occasional "Golden Fleece Awards," Senator William Proxmire "has been doing a disservice to himself, our country, science, and democracy," says Mr. Newman, who's recently retired from a career in long-range planning for General Electric Co. Mr. Proxmire's attacks have enforced on science "the same type of 'defensive' research that crazy malpractice laws have forced upon our physicians," he says, "[thus] reducing the effectiveness of the scientific community."

Mr. Newman's attack was occasioned by an editorial in the *Stamford Advocate* in which Senator Proxmire was commended for his efforts to guard taxpayers' money. The case in point was a Proxmire "Golden Fleece Award" to Stanford Research Institute for a study of future transportation needs and alternatives.

Having read the S.R.I. report, Mr. Newman found it "a delight . . . professional, informative," resulting from research that was "well planned, well executed, creative, and thought-provoking. It examines in great — and needed — detail the current status of each transportation segment, the innovations now apparent, the expected trends to 1995, and the probable sets of change, deteriorations, and improvements to the year 2025."

A far cry from Senator Proxmire's condemnation of the same report for its conclusion that if colder-than-normal winters return to the northern half of the U. S. "a very large number of people will be forced or attracted to move to the South and Southwest."

Now Mr. Newman has been challenged by the Editor of the *Stamford Advocate*: "If Senator Proxmire is in fact an enemy of science, surely the men of science know this as well, if not better, than Mr. Newman," wrote the *Advocate*.

"Let Mr. Newman, in short, show that the name of Proxmire is a dirty word in the scientific world . . ."

Readers of the *Review* who want to join the contest are invited to write to Mr. Newman at 381 Eden Road, Stamford, Conn. 06907.

tems. It turned out that he was old but not forgotten, because recently he received a patent award from the Navy for participation in the invention of a high-powered transducer used in a number of sonar systems. . . . **Gus Rossano** writes that he is still going strong as Professor of Air Resource Engineering at the University of Washington in Seattle. He has also been culturally enriched by recent trips to Japan, Taiwan, Philippines, Iran and Egypt.

Bruce Leslie is still Senior Vice President, Allendale Mutual Insurance Co. He had two trips to Europe in 1977 as expert on insurance for large industrial risks in developing countries. Bruce also moved into a newly-built house on the shore to further enjoy his sailing hobby. . . . **Harold J. McGillivray** is presently district manager of Pittsburgh Testing Laboratory in Tampa, President of McGillivray Land Co. and President of Bay City Equipment Co.

Our sympathy goes to **Henry Rumble**, who lost his wife in December.

The following information comes from the questionnaires and biographies which have been arriving over the past four months. At this writing our magic number is 14. The class has 14 professors, 14 company presidents, 14 owners or partners — what's more, 14 members have already retired. So far, nobody has 14 grandchildren. **Nick Barbarossa** leads with ten, followed by **Cranston Heintzelman** with nine and three others with eight each. Come to the reunion and learn more startling information. If you can't make it, send in your class dues and get the reunion book. — **A.L. Bruneau, Jr.**, Secretary, Hurdman and Cranston, 140 Broadway, New York, N.Y. 10005

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John Noyes, '38, has leadoff honor this month because his classmates read the column above, and they naturally scan this column for news of their '39 friends. John and June visited here during March. We shared two unusual events:

During lunch we overlooked the Pacific Ocean and saw, less than a mile from our table, a number of whales surfacing and blowing as they were making their annual northward migration;

At the Torrey Pines Hang Glider Port we saw a young pilot fasten harnesses on his two large dogs, then clip the harnesses onto his hang glider. Then he stepped off, westward, over a 300-foot cliff into an upcurrent of air which caused the pilot and his two buddies to soar away in a graceful upward arc. Can you just imagine John and June returning to conservative St. Louis after their 4,000-mile trip to the wild West, and reporting to their semi-interested-but-polite neighbors, "You're not going to believe this, but. . ."

Robert L. Frank was recognized for his significant and long-lasting contributions to the development and fostering of Loran, when he received the Medal of Merit from the Wild Goose Association. . . . **Mike Herasimchuk** and his son, Jon, have won the father-son championship at the San Con Valley Country Club, and they invite challengers to come and share. . . . **Wes Kuhrt** recently spoke on "In What Do You Believe" before a group of Methodist men in New Canaan, Conn.

Wes is now President of Sikorsky. During his career he led a number of research programs on axial flow compressors, turbines, afterburners, high-power lasers, boron filaments, plasma physics, propellant chemistry, and fluid mechanics. He has patented a number of his inventions. **William C. Love** is Founder and President Emeritus of the International Association of Jazz Record Collectors. Bill said he would enjoy visiting with those who share his interest in jazz records, but he didn't say whether or not to visit about his civil engineering profession. . . . **Manning Morrill** and Connie continue to be busy, Manning as acting Chief Executive of Hersey Products and Connie starring in some dramatic roles. . . . **Gordon Pope** left his plastic molding business in Puerto Rico long enough to go salmon fishing in Iceland. Gordon makes the happy report that four generations of Pops were in Puerto Rico for the 1977 Christmas holidays. . .

Sid Silber and Jean brought their family to the San Diego area for the Christmas holidays, and they visited us. Sid continues to spearhead real estate development projects, and Jean wrote she is telling friends about the macadamian nuts which grow in our yard and the marguerites which grow in our kitchen.

Bob Touzalin retired from Interlake Steel Co. and he and Aletta toured Germany, Austria, Switzerland, France, Belgium, and England. One of Bob's extracurricular activities has been Secretary of the Pewter Collectors Club of America, an organization of 700 members. The English counterpart Society has only 40 members, but some of them made Bob and Aletta very welcome during their visit in England. Bob and Aletta wrote that when in England they usually stayed at "Bed and Breakfast" hostels because "that is the way to get the feel of the people." After their return to the U.S., Bob and Aletta sold their lovely home located on one of the fairways of the golf course at Crete, and they are now building another home off the ninth fairway of the Country Club at Naples, Fla.

Bob Casselman continues to demonstrate depth in differing career achievements. Two prior significant career contributions were to Polaroid in its early sales efforts and to the Commonwealth of Massachusetts in an effort to improve its efficiency. Bob's latest thrust is to help the Boston Museum of Fine Arts raise \$20 million for renovations and improvements. You can write to Bob at 465 Huntington Ave., Boston 02115 for information about how to contribute and generate concurrent gains for yourselves.

Speaking of fund-raising, some of that is going on at our alma mater these days. Classmates can contact **Fred Schaller**, 10 Schaller St., Wellesley, Mass. 02181 for advice about where to send the long green with the short future.

George Beesley and Eleanor continue to make their home in Lynnfield, Mass., and George commutes regularly on consulting activities between Washington and Montreal. When you drop us a line, George, give us the word on how the secession movement is coming along north of the border.

Gus Hunnicke and Prilla also feature in the news these days. Their daughter, Debbie, passed her bar exams and is now licensed to practice law. Congratulations to you, Debbie, and share them with your Mom and Dad. Gus and Prilla recently enjoyed a three-week sailing vacation around the British Virgin Islands.

Joe Dana and Jean live in Andover where they play some tennis, manage the manufacture and sale of medical supplies, and demonstrate to their seafood-loving guests their extraordinary skills in extracting goodies from steamed crabs and lobsters.

Nick Carr is in Greensboro, N.C., but sends no detailed news. Nick: drop us a line, and let's remind our other classmates to do likewise. — **Hal Seykota**, Secretary, 1421 Calle Altura, La Jolla, Calif. 92037

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Busy Beaver: Contributors to the Alumni Fund know that **N. Bruce Duffett** continues to serve as the Class of 1940's representative to the Fund. The easiest part is sending the check. Bruce devotes many hours over many months to the effort. We send him thanks.

A Restoration Play: **Walter C. Kahn** is the head of Arthur G. Henning, Inc. in Mount Vernon, N.Y., but his passion is the expert repair of objets d'art and expensive bibelots — crystal, ivory, gold, silver, stone, or wood, you name it. He promises to carry on this unusual hobby as a retirement vocation in his Westport, Conn., home.

Se Habla Espanol Aqui: **George R. Weinbrenner** has recently been elected Secretary-Treasurer of Hispano-Technica, S.A., a consulting firm specializing in introducing high-technology opportunities to Latin America.

Transparent: **Judson C. Rhode**, in Pisgah Forest, N.C., is the new Director of Film Process Engineering for Olin Corp. Judson has both his

bachelor's and master's degrees from M.I.T.

Are They? **George O. Lof**, our solar expert resident at Colorado State University, discussed the "Compatibility of Solar and Conservation Policies" at a symposium on energy held last January in Colorado Springs by the American Chemical Society.

Verbatim: From last month's Class of 1939 notes, Hal Seykota has sent news of '40 men **Robert G. Fife** and **Nils M. Rosenberg**: "Bob Fife wrote from Aptos, Calif., that he and Maisie continue to be busy at law and are looking forward to a visit from their son, Ragan, who is working in Australia. Nils and Janet continue to reside at Broadmoor in Seattle and will be making their annual pilgrimage for several weeks on Maui."

Roll Call: Did you sometimes think that your alma mater would never lose track of you? Here are a few lost souls we would like to hear from or of: **Joseph Blackman** (Chemistry), **Harry F. Butz** (Civil Engineering), **Albert Erickson, Jr.** (Chemical Engineering), **Bunlue Jubandhu** (Aeronautics), **George R. Mounce** (Electrical Engineering), **Peter G. Park** (Management), **Isabel Shaw Rowe** (Architecture), and **Frank L. Sheldon** (General Science and Engineering) — **Frank A. Yett**, Secretary, 1405 Ptarmigan Dr., Walnut Creek, Calif. 94595

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I received a good letter from "**Hawk**" **Shaw**, who is still busily plying the medical trade in lower New Hampshire. He tells of some problems that **Bob Rines** is having with his baby law school. From the tenor of the note, both Rines and Hawk Shaw are keeping things pretty well stirred up in their legal and medical professions in New Hampshire. . . . **Robert Seamans, Jr.** has been elected to the Board of Trustees of the Sea Educational Association. This is an educational institution based in Woods Hole and is devoted to teaching liberal arts college undergraduates about the marine environment and the marine heritage.

Ed Edmunds has been elected a vice president of UGI Corp. with headquarters in Valley Forge, Penn. He is operating UGI's AmeriGas Company marketing compressed and liquefied industrial gases. As a result, Ed and Charlotte have moved from warm and sunny El Paso to cold and snowy Wayne, Penn. We wish Ed continued success in his new position.

Carl Zeitz, hustling as usual, has expanded his packaging activities to include everything in the field: corrugated, folding and set-up boxes, plastic, vacuum-formed, skin and blister packing, and also pressure sensitive labels and tapes. He claims that all of this keeps him "almost too busy to play golf." I doubt it!

In a good and newsy letter, **Bill Rote** tells of his retirement as Vice President of the Equipment Engineering Division of Poloroid effective December 31, 1977. Bill and Ann will be spending about eight months each year at their condominium on Siesta Key in Sarasota, Fla. Bill plans to set up a small office and a lab to do some consulting, mainly in the process control and photographic areas. Bill and Ann have an 11-year-old grandchild via daughter, Nancy, who is a media specialist in the Watertown (Mass.) school system. Son, Bill, junior, is a chef with Service Systems Division of Del Monte Foods. We wish Bill happiness in an active and rewarding retirement.

Charles Ruckstuhl brings us up-to-date. He, **Jerry Coe** and **Al Clear** are about to attend their 40th reunion at Exeter. Charlie and Muriel have also planned a three-week trip to the island of Maui. They'll visit Lindbergh's home there and look over the deep-space surveillance site on the volcano. . . . **Lloyd St. Jean** has recently joined Advanced Management Systems of McLean, Va., as a senior associate. Lloyd writes that he has made an overnight switch from being an electrical engineer (after all these years!) to a hydraulic engineer. He is handling some special assignments for the Town of Huntington (New York). I wonder if it's septic tanks?

One obit this month. Our good friend and neighbor **Geza Neuman de Vegvar** passed away early in March. Geza was our quiet, continental Hungarian

classmate. He had been Chairman of the Board of DeVar Industries, which was a pioneer in solid-state electronic controlled devices. That business was sold to Bell and Howell in 1961. Since then, Geza has been a Director and Vice President of the Manitoba Sugar Refining Co. and was quite an international entrepreneur in cattle and hides. He was active in our New York M.I.T. Alumni Center and a member of the Board of Education in his home district of Woodlands. We extend our sincerest sympathies to his wife, Erna, and to the family. — **Ken Rosett**, Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

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We're rolling along in high gear toward a grand 35th Reunion, to be held on the M.I.T. campus from June 8 through 11. It is going to be a bargain affair because M.I.T. is furnishing accommodations in the dormitories on Memorial Drive at practically no cost, and the dining hall banquet food, although not five star, will be a refreshing reminder of our salad days. There are tennis courts available for our use, and the sailing pavilion will welcome us. The cruise on Saturday, June 10, across Boston's treacherous harbor to George's Island for a real New England clambake will be followed by an informal buffet. We will have tables on the floor at the Pops on Thursday night, and a great cocktail party and dinner dance on Friday night. For last minute reservations, write or call **Kemp Maples**, 71 Cliff Rd., Wellesley Hills, Mass. 02181, (617)235-6926 or (617)862-6222. **Ken Warden**, our class president, has had wonderful cooperation from the professionals at the Alumni Office, who do most of the preparations for us, including hats, noisemakers and souvenirs. So there you are.

Grapevine news has it that **Bill Verrochi** is now president of Pennsylvania Electric Co., in Johnstown. Bill and Gloria's four daughters are here and there: Elizabeth graduated Curry College in Milton, Mass., and is a recruiter for Burdett College in Boston; Suzanne is a senior at Boston College; Kathryn is a student at Springfield College and Barbara is at home, in high school, Bill and yours truly were fledgling engineers at Jackson and Moreland in Boston during the late 1940s, and I never imagined then that he would become a utilitarian, in view of his rather pious background.

If you will pardon my affrontery, I must convey the reunion committee's request that you bring pictures of your grandchildren with you to the reunion. The inconvenience this task will impose will be far outweighed by the pleasure which others will derive from their viewings. — **Dick Feingold**, Secretary, 779 Prospect Ave., West Hartford, Conn. 06105

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On this beautiful spring-like day in New England, with the sunshine and warmth melting the high gray snow piles, Melissa and I went to the Annual Spring Social of the Boston Section of I.E.E.E. Often we meet at least one Course VI classmate in the audience or in the distinguished roster of new Fellows, but not this time. We did however meet Doc Edgerton who rarely misses these events. He and Mrs. Edgerton say "M.I.T." with so much spirit and grace in so many places.

In early March, we heard from two classmates in answer to the observation made in the February classnotes about the Project Whirlwind photograph in the October *Spectrum* (I.E.E.E.). **Harry Kenosian** wrote from Berwyn, Penn., and places the scene at the "Barta" Building sometime in 1948. Harry tells us he is "presently at the Krusen Research Center in Philadelphia. Our operation is devoted to patient rehabilitation. The Center has a mixed bag of medical types, engineering types and biomedical engineering types. My job is 98 per cent engineering on instrumentation used for measurements of human locomotion. We get into all sorts of interesting situations and I have to be cognizant of digital and analog computation as well as signal conditioning for data acquisition.

We even have a speed-trap radar for measuring velocity. Lately we have been using Helium-Neon lasers and expect to get into some tricky magnetic field measurements."

As Harry's long-time friends would expect, he's still deep in technology: from WMEX to Medics! His daughter at Bryn Mawr is majoring in mathematics; his son is in the ninth grade. Harry confirms that the other '44 in the picture is **Gene Sard**.

From Gene himself, in Huntington, N.Y., we received acknowledgement of his presence in that photo. While modestly limiting his own activity at that time to pursuing his master's degree, Gene remembers that Harry "made a real contribution to the project in designing all sorts of pulse test equipment."

Thanks to you both. For us it is extremely gratifying to hear from our classmates, about themselves, and especially about each other. All we need now is to hear from "**Doc**" **Dube** and Stan Berinsky, '48.

By the time you read these notes, we will have had our 34th reunion at the Tides Inn in Virginia. We hope we will have met many of you there. If you do not join us in Virginia, please try to visit M.I.T. for Technology Day. The program is well designed, and the talks are interesting and informative. Drop us a line if you intend to be there and we'll make a special effort to get together on Friday, June 9, Technology Day. — **Melissa** and **Newton Teixeira**, Secretaries, 92 Webster Park, West Newton, Mass. 02165

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Jim Goldstein has written us a very nice letter and we are most appreciative. Jim is now in his 25th year in the practice of architecture-engineering-planning with his firm, James Goldstein and Partners of Milburn, N.J. Jim's lovely wife, Rosanne, whom you will remember from class reunions, is their business manager and head of the interior design department. Jim and Rosanne have two sons who are alumni of the M.I.T. School of Architecture — Roger, '74, who has two degrees in architecture and Eliot, '77, who will enter the Graduate School for his second degree. This is the first time in the history of the School of Architecture that two sons of an alumnus have become alumni of the School. Roger is working in the Boston area where his wife, Cindy, is teaching. Eliot is working as a ski instructor at Smugglers' Notch. Jim visited Washington recently and dined with Jean and **Herb Hansell**. Herb is Chief Counsel to the State Department under Secretary Vance.

Roger Hickler, who graduated from Harvard Medical School after attending M.I.T., has been named Lamer Soutter Distinguished Professor at the University of Massachusetts Medical School. The award is named after a former dean of the school. Dr. Hickler is a leading authority on hypertension and will head a program dealing with the problems of aging. Dr. Hickler has previously been the first director of the Pearl Memorial Geriatric Clinic at Peter Bent Brigham Hospital in Boston. Before that he served as assistant professor of medicine at Harvard and has been in the staffs of Peter Bent Brigham Hospital, Boston Lying-In Hospital and West Roxbury Veterans Hospital. Roger is the author of more than 100 scientific publications and is serving as President of the New England Cardiovascular Society.

Felix E. Browder has been appointed visiting professor of mathematics at M.I.T. He is one of the world's leading authorities on partial differential equations and was previously the Louis Block Professor of Mathematics at the University of Chicago. Following graduation from M.I.T. with an S.B., Professor Browder received his Ph.D. from Princeton in 1948. . . . **D.R. Crinklaw** writes that he is doing nicely and is working for T.R.W. in Avocado Grove, Calif. Until next time — **Russ Dostal**, Secretary, 18837 Palm Cir., Fairview Park, Ohio 44126

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A couple of years ago **Richard Mela** left his position as Director of Corporate Development at Raymond Precision Industries Inc. of Middletown, Conn., for a second career as a small businessman and teacher. He opened a movie theater in Essex, Conn., and he teaches a course at Mitchell College, "Starting or Buying Your Own Small Business," which provides tools to help in the search for a small business to buy, its evaluation, and its operation. He has also participated in mid-life career change studies at the University of Connecticut.

Sid Smith has been named as this year's recipient of the Jack A. Kraft Memorial Award for his contributions to the field of human factors engineering, an area that deals with the compatibility of humanity with its technical environment. Particularly mentioned was Sid's "pioneering demonstration of computer-generated speech in an interactive medical diagnosis system" first published in 1970, which used MITRE's talking computer. Sid became interested in the human side in an industrial psychology course he took as a graduate student at M.I.T. He went on to complete a Ph.D. in psychology in 1954, his third M.I.T. degree. Sid is currently at MITRE working on a project for the Bureau of Consular Affairs of the State Department in which he will evaluate the feasibility of issuing computer prepared machine-readable visas.

Walter Kansteiner writes, "Gradually turning more responsibility over to my son-in-law who is our new general manager (Kansteiner Machine Co., Chicago) which gives me more time with the two grandchildren as well as being able to get in more hunting and fishing." . . . By publication time, **Donald Dean** should have returned from his February Quarter Century Club trip to the Mid East, which included the Suez Canal and the Red Sea. Perhaps he will share some of his experiences with us next month. . . . **Vince McKusick** fills us in with a few details: "After 25 years of private practice in Portland, I was sworn into a seven-year term as Chief Justice of the Supreme Judicial Court of Maine on September 16, 1977. As Chief Justice I am head of the Judicial Department of the State." (January Notes have more on his appointment.)

Jordan Baruch, Assistant Secretary for Science and Technology of the Department of Commerce, was quoted in *Science and Government Report*, November 15, 1977. Jordan defines infratechnology as "that underlying set of techniques and capabilities on which individual firms can build actual products and processes that make them competitive." He cites programs in China, Germany, and Japan as examples of competitive efforts which threaten U.S. industry's ability to maintain a lead and remain competitive, making a case for a new federal role in helping to develop infratechnology. He said the program "would be built upon cooperation between government and industry and have as its purpose the development of new knowledge, prototype technology, and mechanisms that will promote the generation, improvement, transfer, and application of technologies."

The sad news has come of **Fred Brodersen's** sudden death from a heart attack on December 10, 1977. I shall print more when I have it.

Technology Day is almost here. Hope to see you at the Micro-reunion at the luncheon table! Keep the messages coming. — **Virginia Grammer**, Secretary, 62 Sullivan St., Charlestown, Mass. 02129

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The Reunion Committee meeting in February included **George Clifford**, **Don Noble**, **Graham Sterling**, **Sonny Monosson**, **Bob Sandman**, **Harold Ottobri**, **Verity Smith**, **Milton Slade**, **Norm Seltzer**, and yours truly. **Don Noble** wrote a tentative program for discussion and one of the accepted suggestions was to have a clambake at noon on Saturday. For early arrivals on Wednes-

day, June 7, information will be available in McCormick lobby about restaurants, M.I.T. facilities, Freedom Trail, and where to buy tickets for plays and sporting events. Our class program begins Thursday at 5:30 pm in McCormick. Don is checking out the best place for dessert after the Pops.

Graham Sterling and I had lunch in Norwood, Mass. Graham is Vice President of Planning and Control at Analog Devices. Analog was formed in 1965, and they reached their planned goal of \$50 million sales in 1977. Analog manufactures semiconductor data acquisition components for manufacturers of instrumentation. Graham and Judy live in Norfolk, Mass., with their youngest daughter who is in high school. Their son, Arlie, graduated from M.I.T. and is spending this year in Norway. Graham recently participated in a telephone for the M.I.T. Alumni Fund. He spoke to **Tom Cahill** who is enjoying his practice of internal medicine in Pennsylvania. Tom's daughter, Patricia, graduated from Allegheny in 1975 and Tom, Jr. from Bucknell in 1977. Tom and I were neighbors on the fifth floor of Goodale during our freshman year. **Carl Accardo** and **John Dulchinos** were also neighbors and now they are running Epsilon Laboratories in Bedford, Mass. ... Graham also called **Charles Bright**. Charles has written a book, *The Jet Makers*, about the aircraft industry. The book will be published by Regents Press of Kansas during 1978.

Sonny Monosson, President of American Used Computer Corp., has launched a new company, American Terminal Leasing (A.T.L.). A.T.L. will provide users with short-term (90-day minimum) leasing of new terminals as alternatives to outright purchase of their terminal requirements. ...



Dan Fink '48

Dan Fink has been appointed Group Executive of the G.E. Aerospace Group. Dan has been Vice President and General Manager of the company's Space Division in Valley Forge, Penn., since 1969. In his new role, Dan assumes responsibility for three other G.E. aerospace divisions with total employment of 18,000 people. The Group businesses include electronic and high technology products such as earth orbiting satellites, radar and sonar systems, armament systems and aerospace instruments. ... **Donald Floyd** enjoyed Brussels so much 20 years ago, he and his wife, Lynn, have returned — this time with N.A.T.O. International Staff. His children are in or have finished college in the U.S. Don and Lynn are renting a lovely home 15 minutes from Grand Place, the collection of 17th century buildings surrounding the 14th century Hotel du Ville. Don will be there through 1981. Call him if you are in Brussels.

Stan Abkowitz is President of Dynamet Technology in Burlington, Mass. *Iron Age* magazine wrote an article about Dynamet's use of cold isotactic pressing (CIP) to make complex shapes. In CIP, a pressure of 60,000 psi is applied from all directions to powder metal in an elastomeric mold. After pressing, the parts are sintered to diffuse the powder together. Dynamet has developed a range of products which can be made with a desired level of density, purity, conductivity, corrosion resistance, and machineability. Applications for the parts made by CIP include a corrosion-resistant titanium ball valve, copper conductors, titanium cannisters for a centrifuge, and a

neutron shield for spent nuclear fuel.

Willis Perkins, Jr. was promoted to Colonel in the Army Reserve and is now commander of his reserve unit, the 1064th RTU (Logistics). Willis' original commission was from M.I.T. R.O.T.C. During the past year he spent two weeks in India on business visiting Bombay, New Delhi, Calcutta and Madras. ... **Howard N. Smith** is Secretary of Economic Affairs for Massachusetts. Howard recently took part in a ground-breaking ceremony in Bedford at the site of an addition to Spire Corporation's new plant. Spire's founder is Roger Little, '64. Spire's principal operations are in the nuclear science and solar energy fields.

Jim Manson wrote an interesting letter about his family and his newly-formed consulting business. Nancy and Jim continue to live in Concord, in the same house for the past 25 years. Their oldest daughter Cynthia graduated from Mills College in 1973 and is working at Orion Research. Polly graduated from Colby Junior College, married, and lives in Waltham. She had a daughter who is Jim's first grandchild. Mark started at Dartmouth just as the girls left college, so that their budget would remain in slim and trim shape. The biggest change that has taken place is Nancy and Jim's role reversal. These days he sees her off to work, and then heads to the kitchen to clean up the breakfast dishes. Nancy's a specialist in learning disabilities and works in the Concord Middle School reading labs. Jim is starting a business after working for the Air Force in x-ray and ultralight measurements. He is working on developing a viable product based on some photon counters he had designed while with the government. Jim sees **Carl Accardo** occasionally since he is in the same field. — **S. Martin Billett**, Secretary, 16 Greenwood Ave., Barrington, R.I. 02806

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My return from a three-week Florida vacation in mid-March coincides with some welcome above-freezing weather in Concord. It appears possible that spring will actually be with you as you read these notes in May.

David D. Gaillard reports that he and his wife Babs are "gifted with two lovely grandchildren, both of whom live in New England." ... Another of **Fletcher Eaton's** "President's message" to the Engineering Societies of New England has arrived, this one dealing with technological obsolescence. Fletch proposes that you alone are responsible for whether technology plays the role of an enemy or a friend in your life.

Alumni Fund notes provide the following: **John Alger** reports a recent move back to the Schenectady area as Manager, Technology Assessment and Planning, in "our" (Hot Point/G.E.) Energy Systems and Technology Division. His son Mort is enjoying being a third-generation senior chemical engineering student at M.I.T. Only one 11th grader left at home, since his daughter is married. ... **Frederick Reusswig** writes, "Family now includes three grandchildren. Joined Management Advisory Council for Center of Management at University of Iowa. Continue as M.I.T. Education Counselor. Job as Head of Operations Division for Stanley Consultants remains challenging, with increased client demands for energy and environmental services and higher performance levels vis-a-vis cost and schedule control." ... **Harvey Tuck** exults, "Sixteen years with I.B.M. and love it. Two daughters in college and love them. Sonna and I will be married 25 years, and we owe M.I.T. for this good life."

By coincidence we have two press releases involving **E. Milton Bevington**. He co-chaired an M.I.T. luncheon meeting in Atlanta on November 30 for which Chancellor Paul Gray was principal speaker. And the Flintkote Co. in Stamford, Conn., elected Milt to their board of directors last October. I note from the announcement that he is now President and Chief Executive Officer of Servidyne, Inc., in Atlanta. ... **Ford Miskell** sent in a business card which lists him as Market Manager, Rotary Equipment, with the B.S.P. Division of Envirotech Corp., Independence, Ohio. I trust Ford and our other classmates in the Ohio area

survived the terrible weather, which is still continuing as I write these notes in late January.

Roland E. Derby, Jr., died on Christmas day, 1977. The 1961 alumni register listed him as President of the Derby Co.; in 1975, his business was listed as Nyauza, Inc., both in Lawrence. He lived in Tyngsboro. I have no other information now.

Thomas Hudson, Jr. died January 15, 1978, of cancer at the age of 50, at home in Wallingford, Penn. Since February, 1976, he had been general operations supervisor for budgets and costs for Bell Telephone of Pennsylvania. He had worked for Pennsylvania Bell and A.T. & T. in New York for 28 years since his graduation from M.I.T. in electrical engineering. He was a member of the M.I.T. Advisory Council and was also active in local affairs: Wallingford and Nether Providence Cub and Boy Scout and Parent-Teacher groups; former chairman of the Wallingford United Fund; and former area chairman and district leader of the Nether Providence Republican Party. He is survived by his wife, the former Phyllis Forster; two children, Kathryn and T. David; and his mother, Mrs. Thomas Hudson, Sr., to whom go our condolences.

A second dinner meeting on March 16 of the 30th Reunion planners attracted **Jim Christopher**, Eunice and **Joe Schneider**, and Nell Eaton in addition to **Fletcher Eaton**, Jean and **Harry Lambe**, Roz and **Stan Margolin**, and Sonya and **Frank Hulswit**, all of whom attended the first meeting as well. **Ira Dyer** couldn't make it because he left for the North Pole that day. **Mickey Ligor** was teaching a class at Northeastern, and **Russ Cox** was out of town. Stan Margolin and Nancy Russell (of the Alumni Office) reported on Bermuda locations and costs. We hope to confirm a location at our next meeting on May 1.

Best wishes to all. — **Frank T. Hulswit**, Secretary, 77 Temple Rd., Concord, Mass. 01742

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Margie and Louis Stark are enjoying vacation activities. During the summer of 1977, they covered 50 miles of the high Sierras of California. In November they sailed in the Grenoline Islands off the West Indies for 12 days. Between vacations, Lou is still at Hughes Aircraft managing the International Research and Development program.

William N. Johnston was elected President of the American Bureau of Shipping, effective November 1, 1977. He is the 12th president in the 115-year history of the international ship classification society. He joined A.B.S. in 1951 and served as a surveyor for seven years in Europe and eight years in the U.S. before being appointed principal surveyor for New Orleans. In 1968 he was appointed principal surveyor for Western Europe, headquartered in London, England. He returned to the U.S. in 1972 when he was appointed assistant to the chairman. Bill was elected a vice president in 1974 and Senior Vice President in 1976. He is also Vice President of A.B.S. Computers, Inc., a wholly-owned subsidiary of A.B.S.

In November 1977, Corning Glass Works of New York City announced the appointment of **Donald E. McGuire** to Manager, Engineering and Business Development. Don joined Corning in 1955. ... We received word from **Richard Fox** that he was elected director on the Marin Municipal Water District Board, and right after that California entered into the worst drought year in history, during which each customer was rationed to about 40 gallons or less of water per day. Based upon recent weather reports, Dick is having new problems in California.

William H. Enders has been promoted to Vice President and General Manager for the International Division of Rockwell International's Admiral Group located in Schaumburg, Ill. Bill joined Rockwell International in 1974 as Vice President, Business Development and Consumer Operations in Pittsburgh. In September of 1975 he was named Vice President, Marketing, for Admiral's International Division, the position held before his recent promotion. Prior to joining Rockwell International, he held executive positions with R.C.A.



Herbert D. Benington, '50 (left), Vice President of Mitre Corp. and General Manager of its Metrex Division, has finished a major reorganization of the Division. Its work in civil and medical information systems are now consolidated, and Mr. Benington's col-

league Ellis L. Rabben (right) has joined a Battlefield Systems Integration and Evaluation Division "to develop new fields of activity for Mitre support to the Department of Defense." (Photo: Norman L. McCullough from Mitre Matters)

and Magnavox. His son, Gregory, received his M.B.A. from Lehigh in June, 1977, and is a financial analyst for Ford Motor Co. in Dearborn, Mich. His daughter, Kimberly, is thriving in her junior year at Mt. Holyoke College and plans never to leave New England, particularly Massachusetts. — **John T. McKenna, Jr.**, Secretary, 2 Francis Kelley Rd., Bedford, Mass. 01730

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W. Gerald Austen was elected President of the American Heart Association. He continues as Chief of Surgery, Massachusetts General Hospital and Edward D. Churchill Professor of Surgery, Harvard University. . . . **William J. Cavanaugh** has been elected President of the National Council of Acoustical Consultants. Bill established his own consulting practice in 1970 following many years with Bolt Beranek and Newman. He has been involved in the acoustical design of many thousands of building projects, has been a lecturer in architectural acoustics at M.I.T. and at a number of other leading schools of architecture, and serves on the Commonwealth of Massachusetts Special Legislative Commission on Noise Control Legislation. . . . **Karel Den Tex** retired from I.B.M. December 1, 1977. He will continue to live in Rochester, Minn., and take his time to "retread." . . . **Bill Dodrill** was named one of four outstanding teachers at West Virginia University in 1976-77 for his innovative work in the Department of Computer Science.

Herb Graham recently completed his tenth year with T.R.W. and is a Task Manager on the Department of Energy Contracts. He was invited in June to the Soviet Union as U.S. Energy Representative to see their achievements in magneto-hydrodynamics. He is an officer with the National Association of Environmental Professionals and is co-editing a book soon to be published by Ann Arbor Science Publishers. Herb and his wife, Ruth, have two girls and a boy and are residing at 11211 Gainsborough Rd., Potomac, Md. 20854. . . . **S.G. Greco** is an associate engineer with Mobil Research and Development Corp. in Princeton, doing process engineering in the area of gas treatment, and air and water pollution abatement. His 20-year-old son is a junior at N.J.I.T. in chemical engineering and his oldest daughter is at Douglass College. . . . **Avron R. Handleman** left

Monsanto in 1975 after 20 years and established Semi Bulk Systems, Inc. to produce materials handling systems based on one of his patents purchased from Monsanto. His wife, Clayborne, completed law school and passed the Missouri Bar in 1974. They have a girl 20, and a boy 17.

David W. Hubbard reports that a class C Catamaran W of his design successfully defended the "little America's Cup" in August, 1977 in California against an Australian challenge. It is reported in the December issue of *Sail*. . . . **William A. Krivsky** was presented the Francis J. Clamer medal by The Franklin Institute for his invention of the argon-oxygen-decarburization process which revolutionized stainless-steel making. Dr. Krivsky is currently Senior Vice President of CertainTeed Corp., Valley Forge, Penn. . . . **Fred Lehmann** was awarded the 1977 Bronze Beaver in recognition of his distinguished service to the M.I.T. Alumni Association. . . . **Peter J. Philliou** coordinated a Wentworth Institute program to improve the English language proficiency of 32 Saudi students from the University of Petroleum and Minerals in Saudi Arabia. Dr. Philliou is Director of Wentworth's curriculum center.

Clinton B. Seeley was elected President of the medical staff of Melrose Wakefield Hospital in 1976, President of the Middlesex East District Medical Society in 1977; and Fellow in the American College of Radiology in 1977. Clint reports he is still building his home in Andover and is collecting "antique" toys — our age or older. . . . **Sanford Sussman**, Chairman and Chief Executive Officer of Electro Motive Corp., North Myrtle Beach, S.C., recently announced the opening of their El Menco division's new MICA capacitor facility in Port Au Prince, Haiti. . . . **Art Wasserman** was recently named Regional Vice President, Eastern Europe International Marketing Development Services, for Allis Chalmers Corp., Milwaukee, Wis. . . . **Herb Woodson** is Director of the Center for Energy Studies at the University of Texas in Austin. — **Sam Rubinovitz**, Secretary, 3 Bowsar Rd., Lexington, Mass. 02173; **Greg Gentleman**, Assistant Secretary, 818 S.W. Ninth St., Des Moines, Iowa.

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As of March 31, over 169 classmates have indicated that they hope or plan to attend our 25th

New Power for the Nuclear Option

Continuing opposition to nuclear power by an ill-informed minority of Americans is driving the nuclear power industry into oblivion and forcing the U.S. into a position of ever-increasing reliance on oil and coal. It's a policy which puts the nation and its future prosperity in grave jeopardy, says Herbert H. Woodson, '51, Director of the Energy Laboratory at the University of Texas in Austin.

As President of the Power Engineering Society of the Institute of Electrical and Electronics Engineers this year, Professor Woodson pledges his leadership — and that of the Society — to "an all-out effort for energy production — with heavy emphasis on nuclear power" as a solution to "the potential disaster of massive unemployment and economic losses as a result of energy shortages."

"We must reduce oil imports as quickly as possible," says Professor Woodson. "The only solution is to use mature technologies already developed. We simply cannot wait for conservation or alternate sources, both of which have little promise of contributing substantially in the near future. If environmental and health degradation are to be kept to a minimum, the emphasis must be on nuclear power," he says.

"The nation's pro-energy faction is a silent majority," says Professor Woodson; "objective public opinion surveys show that a two-to-one majority of our citizens supports the nuclear option. Yet that option is being foreclosed by a small but extremely vocal and effective segment of our society. As its new President," said Professor Woodson, "I intend to see that the Power Engineering Society is heard."

Reunion on June 8-11. Including spouses and children, our attendance could reach over 350 persons! If you have not yet completed and returned your registration form, please do so now as time is running short. The reunion promises to be a memorable one and is an event that definitely will not be repeated! Don't miss it.

As you know, at every five-year reunion classes elect class officers. If you have any nominations which you would like to submit, please forward them to me.

There is not much news this month. First, a newsclipping. **Robert Barlow** — who has served with Sikorsky Aircraft Division of United Technologies Corp. since graduation — was just appointed as program manager of the S-76 Coast Guard Short Range Recovery (SRR) helicopter. . . . Second, a phone call from ole **Jay Berlove**. He had no new jokes, and was willing to engage in no new bets. But he has a new job — with Chloride — and he and his spouse have just bought a 140-year old Dutch colonial home in Lima, N.Y. — with zillions of rooms — and hinted that *all* of us should come and visit.

Third, and last (but not necessarily least), an Alumni Fund note from **Allan Hoffman**. He's still Professor of Chemical Engineering and Bioengineering (and Assistant Director of the Center for Bioengineering) at the University of Washington (Seattle). And, in his words, "Working on implant materials, especially plastics. Have a research group of about 15 great collaborators. Was Chairman of Gordon Conference on Biomaterials in 1977. Have a lovely family — two kids and a very nice wife who's busy getting her graduate degree in communications. Hope to make my 25th reunion." . . . **Alcon Gallagher** recently spent six months in the beautiful copper country of Chile — on an iron ore project, Huasco Valley.

That's all folks. And, guess what? In only three more months I retire from this job (i.e., that of being the Class of 1953 "pain in the neck") for the rest of my life! Pure pleasure! — **Martin Wohl**, Secretary, 7520 Carriage Ln., Pittsburgh, Penn. 15221

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We hope you are enjoying spring, after a rather severe winter. We received a nice note from **Howard Brody's** wife, Lois. Howard has added to his professional duties at Penn and is now Associate Dean of the Faculty of Arts and Sciences. The Brodys are looking forward to our 25th Reunion which will also be their 25th wedding anniversary. They plan to attend with their three daughters. Their two oldest daughters are now attending the University of Pennsylvania, and the "baby" is a freshman in high school. Lois lamented that "there were no familiar faces" when they attended an alumni dinner in Philadelphia honoring Jerry Wiesner. We hope there are lots of familiar faces at the 25th, Lois!

Now, reaching down to the very bottom of the news file, we find that, locally, **Chuck Masison** has retired his 140,000-mile LTD and bought a fancy new car. . . . Out in Los Angeles, **Paul Stern** is Vice President of the Coldwell Banker Commercial Brokerage Co. — **Dave Howes**, Secretary, Box 66, Carlisle, Mass. 01741; Assistant Secretaries: **Chuck Masison**, 76 Spellman Rd., Westwood, Mass. 02090; **Lou Mahoney**, 6 Danby Rd., Stoneham, Mass. 02180

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REUNION SIGHTINGS!! Our 20th Reunion Committee, piloted by **Frank Tahmouh**, reports a close encounter of the second kind. Messages received indicate that the landing will occur on remote Matha's Vineyard Island at the Harbor View Inn. Class beings unseen for many years will descend upon the island to make contact with their counterparts. To share this close encounter of the third kind, you must send in your reservations now. If you have not as yet assured your place in the sun, here are several "Hot Line" communication links to call: **Martin O'Donnell**,

registration chairman, at 617-729-0071 or **Frank Tahmouh**, chairman, at 617-326-8366. Phone now for details of the sightings! There is still room aboard for all of you, but hurry — the countdown has started.

And remember that for those in the area there will be an advance landing party scheduled after Tech Night at the Pops on Thursday night, June 8. All class members are invited to rendezvous after Pops for a wine and cheese affair at the nearby townhouse of **Mike Brose**. Our "ETD" for the island is on Friday afternoon June 9. Your experience begins with an out-of-this world dinner with your choice of filet of sole, duck or sirloin steak, followed by informal entertainment. You'll need your rest for Saturday's activities which include tennis, bike riding, golf, sight-seeing, sailing and running the '58 mini-marathon. Relax at the cocktail party that night and then enjoy candlelight dinner and dancing 'til the wee hours. On Sunday there will be the famous Harbor View Shore Dinner to share before returning to the present world. Also, the results of the Reunion Class Profile can be yours if you send in your class dues of \$12. This fee helps with the questionnaire printing, processing and mailings to all the class members. Send dues and registration fees to: **Steve Hadjiyannis**, Reunion Treasurer, 127 Long Hill Rd., Franklin, Mass. 02038.

Other news this month is brief because we're sure everyone is planning to meet at the reunion instead of sending news by letter. However, **Cole Bess** wrote to advise us to watch the *New York Times* for the excellent science reports which **Stan Klein** frequently contributes. Stan was named Editor-in-Chief of *Mini-Micro Systems* magazine recently. . . . **Edward Goldman** is now a vice president of Foster-Miller Associates and says he is "worrying about mining equipment, production machines and other mechanical beasts. My wife Benita and I live in Randolph with our three children, Roberta, Neil and Allen." . . . Our last letter comes from **David Rachofsky** who brought us up to date on his doings since leaving the Air Force in 1962: "I've been practicing law in Philadelphia with the firm of Dechert Price and Rhoads for the past ten years. Faith and I and our three children have been living in this area since 1962."

That's all the news this month, folks. We'll see you at the reunion and at the Pops. — **Michael E. Brose**, Secretary, 30 Dartmouth St., Boston, Mass. 02116

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Time to catch up on the few cards and letters that have slowly trickled in during the last few months. **Brad Bates** sent a short note from the Detroit area to record his vote for an on-campus reunion in 1979. Our 20th Reunion Chairman (and recent bridegroom) **Art Collias** met with other locally-based officers and their wives at a recent dinner party hosted by Katie and **Chuck Staples** to briefly outline some thoughts for 1979. We welcome all comments and suggestions for making the 20th a memorable reunion for the class.

From the world of business, **Joe Seidel** is busy planning the future world of sewing machines as vice president-planning for consumer products of Singer. . . . **Phil Beach** is working hard in Brazil launching Campbell Soup in the area. . . . **Malcolm Laughlin** has become a private entrepreneur as a management consultant to the railroad industry. He recently completed extensive travel in the Middle East to study the economic feasibility of a new plant in Egypt to build railroad cars.

On the academic side, **Charles Hill** has recently written a new text, *An Introduction To Chemical Engineering Kinetics and Reactor Design*, published by John Wiley and Sons. Charles has been professor of chemical engineering at the University of Wisconsin since 1967 where he is four-time winner of the Polygon Award as the outstanding instructor in chemical engineering. . . . **Manuel Blum** received the University of California-Berkeley Distinguished Teaching Award for 1977. . . . **Nam Suh**, Professor of Mechanical Engineering at M.I.T., received the Gustus L. Larson Memorial Award of the American Society of Mechanical

Engineers for his outstanding achievement in engineering and in education.

We are starting to hear of the next generation at M.I.T. **Marie Wray** notes that her son entered M.I.T. last September. Marie and Stanley Wray, '56, are computer programmers with Aerospace Corp. in California. Are there other children of the class planning on coming to Cambridge?

Just as we were about to go to press the mail-room delivered a bulging packet of information. **Dwight Crane**, Professor of Business Administration at a local business school up river since July, 1976, has recently published *NOW Accounts: Strategies for Financial Institutions*. . . . A fellow academic at H.B.S. is **Bill White**, whose son and mine are classmates in Newton. . . . **Larry Broutman**, recently elected president of the Society of Plastic Engineers, has returned to Chicago from travel to Israel and Denmark where he chartered new sections of the Society. . . . **Tom Lovejoy** writes from the Big Apple that he is with Blyth Eastman Dillon in the financing area.

Press releases: **Alan Gellis**, who followed mechanical engineering with a law degree from Harvard and then went on to Boeing-Vertol in Philadelphia as senior attorney, has been appointed by Amtrak as counsel for the federally-funded Northeast Corridor Improvement Project. . . . **P. Agustin Rios**, who joined the General Electric Research and Development Center in Schenectady in 1970, has been appointed manager of the Electromechanics Branch where he will direct activities in electromagnetics, rotating machinery, and solid mechanics. . . . **William Butcher** has been promoted to regional manager of Suburban Propane's Eastern Propane Division in New Jersey. Bill has been with Suburban Propane since 1964 and has supplemented work with civic activities. In addition to working with 4-H, raising children and breeding horses and sheep, he is a member of the local zoning board and has previously served as president of the board of education and as a member of the planning board. . . . Returning to the state of his birth, **Bob Williamson** has left Foxboro Co. after nine years, where he held management positions in development and in marketing, to join Metromation in Princeton, N.J., as Manager of Product Planning. One of his responsibilities at Foxboro was the development of their Videospec system, on which he holds patents. At Metromation, Bob will be responsible for assessing future control needs of the chemical processing and petroleum refining industries, and defining computer-based systems to meet these needs.

With less than two years to the reunion, we want to be hearing from you. Drop a short note to **Phil Richardson**, 180 Riverside Dr., N.Y. 10024; **John Amrein**, 770 Greenwood Ave., Glencoe, Ill. 60022; **Adul Pinsuvana**, A.S.E.A.N. Secretariat, 6 Jalan Taman Pejambon, Jakarta, Indonesia; **Bob Muh**, 907 Chantilly Rd., Los Angeles, Calif. 90024; or **Allan Bufford**, 8 Whitney Rd., Newtonville, Mass. 02160

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Tom Courtney has received the 1977 Faculty Research Award from the Michigan Technological University, where he is professor of metallurgical engineering. Tom's teaching specialties include physical metallurgy, materials science, solidification, and mechanical properties. He is currently conducting research on microstructural stability in thermal gradients, fracture, and coarsening. He joined the M.T.U. faculty in 1974 after assignments with M.I.T., University of Texas (Austin), and Babcock and Wilcox Co. . . . **George Walsh** has been named a consulting engineer at the Raytheon Submarine Signal Division, and he recently was elected a fellow of the Acoustical Society of America. George has participated in the design and development of a variety of sonar and underwater acoustic systems, and he has served as manager of ocean systems engineering at Raytheon. He holds 11 patents and has authored over a dozen technical papers. George, his wife, Dianne, and their children, Andrew (11) and Stephanie-Anne (9), live in Portsmouth, R.I.

After eight years of engineering with 3M and G.E. followed by eight years as a stock broker in Minneapolis, **Jerry Levine** has moved to Chicago, where he is a market-maker on the Chicago Board of Options Exchange (C.B.O.E.). He mentions that **Ed Neild** recently was elected chairman of the C.B.O.E. and that **Don Rubovits** is with Teletype in Evanston. And even more news from Jerry — **Bern Schnyder**, director of Research and Development for Corn Processors in Clinton, Iowa, and his wife recently had their first child, a girl. Jerry is interested in contacting any Course X classmates in the Chicago area, and we thank him for taking the time to bring us up to date on himself and on fellow class members. . . . **David Kellermann** reports that all is well in Horgen, Switzerland. Children Laurence and Anastasia are now 7 and 9, and David recently was appointed marketing administrative manager for the inorganics and metals department of Dow Chemical Europe. . . . **Pat Coady** is a senior vice president of Dillon, Read and Co., Inc.

Missing classmate, **Richard Hoffman**, has been located in Griggstown, N.J., not far from my own new address. Super sleuth work, fans, and while we are on the subject, it is time to review another segment from our missing persons file: **Risk, Rod, Rodricks, Rose, Rosenthal, Sabet, Samaha, Sarkies, Saul, Savage, Schneiderman, Seiler, Seymour, Shadoff, Siegel, Slawewski, Smith, Staples, and Stevens**. If you have had close (or not so close) encounters of the third (or any other) kind with anyone on this list, drop a line. — **Robert F. Stengel**, Secretary, 329 Prospect Ave., Princeton, N.J. 08540

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Ah, how the years pass. Here is a note from **Donald Easson** saying that his son Dave is 16 and beginning to look around at colleges. Don says that after 17 years of life in Wilmington, Del., the Easson family has picked up and moved to Greenville, S. C., where he is Director of Process and Environmental Engineering for Daniel Engineering. His wife, Gin, and the children are adjusting well to "the South." I thought Wilmington was in the South, Don! . . . Closer to home **Tom Hastings**, who happens to be President of our class, is enjoying his 12th year at Digital Equipment Corp. where he "has chosen to follow a technical rather than a managerial career path." Recently he helped design VAX-11 which is Digital's new 32-bit mini-computer family, and he is now working on its software. . . . Also in the Boston area is **Arrigo Mongini** who is now the Executive Secretary of the Boston Region Metropolitan Planning Organization. He is in charge of the central transportation planning staff. He is going to be one busy person!

Martin Falxa wrote me a wonderful long letter from which I quote: "One benefit of the worst recorded snowfall in metropolitan Boston is that I get some much needed rest and a chance to pass on some class news. . . . **Byron Hugh Willis** is heavily involved in producing Environmental Impact Statements (E.I.S.) as well as consulting on the ecological impact of mining and construction for both industrial and governmental customers. In October 1976 he published a paper in *Hydrocarbon Processing* on "What You Need to Know About Environmental Impact Statements." Hugh works for Environmental Research and Technology and lives with his wife and two children in Sudbury, Mass. Hugh is currently doing an E.I.S. in the state of Washington for the proposed oil terminal in Puget Sound and the proposed northern tier pipe line which are planned to transport crude oil to the Midwest. A couple of years ago while flying to the site of a proposed strip mine, Hugh's plane was forced by bad weather to land at an airstrip near my old hometown of Buffalo, Wyo. Unfortunately, he blinked and never saw the town. The people back there think I'm crazy to live where there are more people than sheep.

Carl Eben lives in the San Francisco Bay area. He is a key person in Bechtel's computer operations. Carl was in charge of planning the compu-

ter applications and installations for the Alaska pipeline. More recently he has been in charge of Bechtel's in-house conversion to a new mammoth computer system. His wife, Judy, is teaching at City College in San Francisco. . . . **Peter Bankson** has had a distinguished Army career primarily in the Research and Development Command although he also served two tours in Vietnam. Pete is now working directly for Defense Secretary Brown. Pete is very serious, thorough, objective and in my mind the ideal type of person for a military leader. Pete also writes beautiful poetry on the side. His wife, Marjory, is a potter and a retreat leader.

Martin goes on: "Our second son, Justin Sauvour, was born last July, and now that he is crawling he is conducting experiments in every part of the house. I'm still a senior scientist with Polaroid but now have several labs and am involved in several new film products including SX-70 improvements. We are currently building a lab which will utilize a mini-computer to do process control on a research level. A couple of years ago I represented Polaroid at an international photography conference behind the Iron Curtain in Budapest, Hungary. I was impressed at how friendly all the Eastern Europeans were. Madelon, my wife, toured museums and the countryside while I was at the meetings. The official languages of the conference were Russian and English yet not one Russian was there! I was told that none of the Russian scientists recieved their official invitations and the Russian government would not let any scientists attend the conference, including the scheduled keynote speaker. I was also told that Eastern European scientists are no longer allowed to visit Soviet labs unless they are specifically asked to consult on an officially sponsored Soviet project. That's scary! Also none of the scientists at the meeting would discuss anything political unless we were walking alone outside. The impressions I received were similar from the East Germans, the Checks, the Hungarians, the Bulgarians and the Romanians. They all seemed afraid to discuss political matters. All of them wanted more trade and scientific exchanges with the West. All were afraid of Russia even though many were active communists. The recent return of the crown of St. Stephen from Fort Knox to Budapest was a brilliant political move since the crown is a symbol of the 'Freedom' of Hungary as well as an important relic from Hungarian history. Incidentally, last summer I was interviewed by an F.B.I. agent who was investigating a Hungarian polymer scientist whom I had helped sponsor at the University of Massachusetts in Amherst. The agent implied that I was un-American because I was helping potential spies visit and study this country. I replied that our way of life was so superior to theirs that the best way to fight communism was to increase the number of cultural and scientific exchanges. I am sure that I am on a blacklist somewhere — or maybe it is the pinklist!"

Thanks Martin for a wonderful and entertaining letter.

Dan McConnell is now a Senior Vice President at Amana Refrigeration in Amana, Iowa. Dan worked at Raytheon until 1969 and then moved to Amana, a subsidiary of Raytheon. He has been working on Radaranges and is on the U.S. Surgeon General's Task Force on Microwave Oven Safety. Dan has been representing the U.S. at international meetings on microwave safety for low these many years. . . . Finally a note from **Ira Jaffe** tells that his daughter, Sheryl, is 10 and his son, David, is 7. Ira is still Senior partner in his firm of Jaffe, Snider, et. al. in Detroit. — **Andrew Braun**, Secretary, 464 Heath St., Chestnut Hill, Mass. 02167

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Richard Marks has been named Principal Programmer of the OS/3 Development at Sperry Univac. . . . **Richard A. Reitman** is the engineer responsible for the Intelsat V DC/DC converters as well as for the converters and high-voltage supplies on the Tiros space environmental monitor. Both these efforts are being carried out at the

Western Development Laboratories of Ford Aerospace and Communications Corp., Palo Alto. . . . **Barry B. Roach** has been named Vice President — Corporate Development of Shaklee Corp.; prior to joining Shaklee he was partner in the management consulting firm McKinsey and Co. — **Gerald L. Katell**, Secretary, 7 Silverbit Ln., Rolling Hills Estates, Calif. 90274

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Next month many of us will be returning to the M.I.T. campus for our 15th Reunion. Just prior to our activities you may want to attend Tech Night at the Pops (Thursday, June 8) and Technology Day (Friday, June 9). The reunion will include a buffet dinner Friday evening, and continues with breakfast and a symposium on campus Saturday morning. Saturday lunch will be in the Rotunda of the Quincy Market, a new shopping area near Faneuil Hall. Dinner and a cabaretstyle evening in Cambridge will climax the day. On Sunday an early dip in the M.I.T. pool and a brunch will get us on our way. For our last two reunions we had 40 or 50 classmates turn out. This year, with the festivities on campus the reunion is easy to get to, lodging will be free and child care will be provided at minimum cost. Let's turn out in force to renew our acquaintance with old friends, M.I.T., and Boston.

Sandra Lensch Cunningham and spouse **Fred Cunningham** sent news from Stamford, Conn. Fred was recently honored by the Connecticut Society of Professional Engineers as the Young Engineer of the Year. The award was made for Fred's work in the design of noncircular gears and the development of numerically controlled machinery for their manufacture. Sandra also gave us some news about **Frances Dyro**. Frances is an assistant professor at Temple University in Philadelphia where she is teaching and starting a muscle disease unit. She was also named "Woman of the Year" for the state of Maine, where she has a medical practice in Portland. What a commute! . . . Those of you who read the *New York Times* last November 22 might have noticed an ad for *Scientific American* featuring **Larry Kazanowski**. Larry is the Special Program Car Planning Manager for Ford Motor Co. and coordinates the advance planning of new cars two to four years before production. The ad included pictures of Larry at work, and at play — sailing and wielding a tennis racket. Larry and his wife Cara also have published a book called *Menus*, a guide to dining out in Dearborn, Mich., the home of Ford.

After a B.S. from M.I.T. in mechanical engineering, **Georges Duval** has changed career directions. He is in his third year of medical school at George Washington University. He writes that he is enjoying it immensely, and he is looking forward to being a doctor. His wife, Linda, just had their fourth child and is now back to work running a home nursing service. The entire family is well and enjoying its stay in Washington, D.C. . . . **Herbert McClees** writes that he had wanted to live in the Pacific Northwest for a long time, and that he achieved that dream in 1977 by moving to West Seattle. He also changed careers from computer services to bank marketing as Senior Marketing Officer at Seattle First National Bank. Behind this move was two years of research into opportunities in the Northwest and the help of many people. His wife Bonnie is working on her doctorate in French literature.

John Brach and his wife Donna welcomed their third child last year. John is serving as Regional Chairman of the Alumni Fund in Atlanta this spring. He reports that Atlanta will have a functioning rapid transit system this year and invites us all to come and ride it. . . . **William C. Smith** informs us that he married Mary Alice Gallagher on November 26, 1977. . . . A press release from Booz-Allen and Hamilton reports that **Joe Nemecek** has been elected a director. Joe heads Booz-Allen's Foster D. Snell division which specializes in product development and evaluation in chemicals, foods, and biological sciences. He was an assistant professor at McGill University before



Two alumni are among four Bell Telephone Laboratories inventors of Chromindur, a new magnetic alloy which will soon take its place in countless devices — including telephones — where durable, high-performance magnetic alloys are required. Chromindur magnets will be cheaper to

make and should outperform and last longer than their predecessors. In the picture with several of their magnets are Gilbert Y. Chin, '59 (left) and Bud C. Wonsiewicz, '63; the other Bell Labs scientists associated with the invention are John T. Plewes and Sungho Jin.

A New Cold-Formed Magnetic Alloy

Two M.I.T. alumni — Gilbert Y. Chin, '59, and Bud C. Wonsiewicz, '63 — are credited with a major role in developing a new magnetic alloy which Bell Telephone Laboratories says will soon take its place in telephone receivers, automobile speedometers, and timer motors for major appliances.

The new material, called Chromindur, is 28 per cent chromium, 15 per cent cobalt,

and the remainder iron — with small amounts of other elements added. Its chief advantage is being cold-formable — which means that tiny magnets can be cut from sheets of Chromindur at room temperature with high-speed punch presses. Chromindur will replace Remalloy — 20 per cent molybdenum, 12 per cent cobalt, and 68 per cent iron — which must be hot-stamped at temperatures as high as 1,250° C.

joining Booz-Allen in 1970. The Nemeć's live in Greenwich, Conn.

So much for now. See you next month in Boston. — **Mike Bertin**, Secretary, 18022 Gillman St., Irvine, Calif. 92715

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Greetings '64! We have good news inputs for this issue — several class heroes, some Christmas cards I've been hoarding for two months, and a bunch of alumni fund envelopes. Keep up the good work, '64!

Starting right in with our Christmas cards, got a nice one from the **Bill Roberts'** family. Bill reminded us that almost three years have gone by since our families last got together in Boston, and we live a whole lot closer to each other now. We'll have to remedy that in the near future! The Roberts (Bill, Linda, Will and David) spent Christmas on the road, visiting Bill's mom in West Virginia and Linda's parents in Chicago. Will, the older of their two boys, has gotten involved in ice hockey via the Youth Hockey Association and is loving every moment of it, particularly with Dad supporting the activity in a coaching role.

Our second pleasant surprise Christmas card came from Cindi and **Dave Morrison**. Dave was just recovering from a broken right index finger (courtesy of the air compressor in his tire shop), and I had to hire a handwriting expert to read his note. He has branched out into the auto parts business and reports that his new venture is surviving well with almost a year of operation under its belt. Dave also mentioned that C.B.S. have taken Pittsfield by storm. Cindi is working as an art assistant in Lenox and all is well with the Morrisons.

Edward W.R. Casper, who has been with Vick Research about 4 years, was promoted from Group Leader to Section Head of Commercial Products last December. For those of you who don't recognize the company name (as I didn't at first), Ed's work deals with all of Vick's currently marketed products, such as NyQuil, Sinex, and Lavis. On the home front, Ed and his wife Gale have two children — Heather (2) and Michael (1). He occupies spare time with karate and his accordion.

I have two more class heroes in the mailbag. **Richard Adamec** and **John Meriwether**, whom we shall save for a later edition.

Now to our Alumni Fund newsmakers: **Juan Crawford** lives in Dublin, Ohio, just outside Columbus, with his wife and four children. He was recently promoted to Supervisor, Small Scanners, at Industrial Nucleonics Corp. Juan went to Buenos Aires this past fall for vacation. . . . Sandy and **Norman Davis** and their three children are living in Atlanta where Norman is General Manager of Southern Moulding and Supply Co., an importer and distributor of picture mouldings, equipment, etc.

Recalling fond memories of their honeymoon in Boston, Ruth and **James Dorr** recently celebrated their second anniversary. They are both involved with Middle Kingdom of Society for Creative Anachronism. James recently had arms approved for Kingdom use and has been named Kingdom Poet Laureat, Anno Societas XI (1976). . . . The **Paul E. Hollands** have two boys and are still enjoying California living. Paul is presently General Manager of the Gardena Division of R and H Corp.

Another classmate enjoying California living is **Robert Muhr**. Like the Hollands, Bob and Joan Muhr also have two sons. The Muhrs live in Santa Barbara, where Bob is employed as the Salary Administration Officer at the University of California. . . . **Ralph Zimmerman** is now a research projects leader for Oakite Products in Berkley Heights, N.J. He and Nancy, a senior staff assistant at the Ford Foundation, have a 5-year-old daughter.

For our part, we spent a very pleasant ten days driving to, around, and back from Florida during February. We visited aunts and uncles, great aunts, grandmothers, great-grandmothers (to our children at least), and in-laws (mine, bless them).



An M.I.T. Man with a Vermont Philosophy: Small Is Better

Advice from John H. Wasserlein, '63, Manager of Scott Paper Co.'s Specialty Paperboard Division in Brattleboro, Vt.: even as it grows bigger, keep it smaller.

Another way of saying it is that Mr. Wasserlein is an advocate of decentralization. His Division is divided into four profit centers, and each has its own general manager and its own technical and sales personnel. There's "a tremendous amount of enthusiasm and motivation" in a group that can control its own business without interference from a higher corporate power, he told *Vermont Business World* early this year.

The small groups in each profit center can render "a great deal of tailor-made service, keeping close tabs on everything from product conception on through manufacturing, marketing, and customer contact," he said, . . . "carving its own opportunities and niches in the marketplace."

There's a "distinct Vermont ring" to all of this, said the Editor of *Vermont Business World*, quoting Mr. Wasserlein: "I'm opposed to any system that tries to make everyone uniform, and to do away with individual initiative." And the Editor also liked the motto on the wall: "It's better to be wrong than average."

John H. Wasserlein, '63, is right at home among the independent spirits of Vermont. "I'm opposed to any system that tries to make everyone uniform," he told Vermont Business World last winter. (Photo: Paper Times)

All in all we enjoyed ourselves, getting a little sun (when it favored us with its presence), going to Lion Country Safari (twice, the kids really loved it), and generally having some R and R.

We spent another lovely day with the **Carl Uhrmachers**, being treated to Indian specialties (Far Eastern variety) for lunch and conventional prime rib for dinner. Barbara has been promoted into program management at Westinghouse and is thrilled about the challenge and opportunity of her new responsibilities. Carl is in a line management slot at Hittman Associates and is continuing his work in the control of air and water pollution in support of E.P.A.

At home, the spring soccer season has begun and George (our 8-year-old) is delighted. Brother Lewis cannot play until next fall and is considerably chagrined over the matter, though he did take ice skating lessons this past winter and George didn't. (Oh, isn't it fun being parents?) Fortunately for Marlene and me, summer day camp does have a program for children who won't be 6 by July 1. (Thank heaven! — since Lewis missed that cutoff by 17 days.)

Keep the mail and those alumni fund envelopes coming. It's really great to hear from you. — **Steve Schlosser**, Secretary, 11129 Deborah Dr., Potomac, Md. 20854

65

We survived the Blizzard of '78, though I will not buy a T-shirt to that effect, and spring is coming. By the time this column appears, the awful winter will be just a memory and Pam and I will be out working on our sailboat. At least now we will not have to hear any more stories about the really bad winters in the "old days."

Our one Class Hero is **Peter Addis**. Peter is an independent computer software consultant and has begun his eighth semester volunteering with the M.I.T. High School Studies Program. He shares his home with four Mongolian gerbils. . . . **Martha and Dennis Bekeny** had a second daughter, Audrey Elizabeth, born on December 2, 1977. Dennis practices pediatrics in New Haven, Conn. . . . Sharon and **Jim Hester** were expecting twins in early February; there is no definite word yet. Jim spent a large part of last year studying what happens to new members after they enroll in an H.M.O. . . . **Howard Ellis** notes that his company (Enviroplan) continues to do well. The Ellises recently moved to Montclair, N.J.

Bob Waymost attended Albert Einstein College of Medicine after leaving the 'tute, did his internship and residency at N.Y. Medical College and a Pulmonary Fellowship at U.C.L.A. He now practices pulmonary medicine in Los Angeles. . . . **L. Scott Duncan** was named a vice president of Booz-Allen and Hamilton, the consulting firm, last year. The Duncans live in Brecksville, Ohio. . . . **Frank Mechura** was also promoted last year, being named General Manager for Corporate Strategic Planning of The Continental Group, Inc. The Mechuras and their three children live in Wilton, Conn.

I have taken on some new roles. In June I will be leaving my hospital administrative position to go into private practice of cardiology and internal medicine in Worcester. I also have a part-time position as Medical Director for the Massachusetts Office of Emergency Medical Services.

You all write, hear? — **Edward P. Hoffer, M.D.**, Secretary, 12 Upland Rd., Wellesley, Mass. 02181

66

After last month's flood of news, this month appears to be a drought.

Saul Moallem writes that last April he was transferred from Toronto to Newark, N.J., where he is a Region Computer Systems Consultant with Control Data Corp. He and his wife, Susan (and daughter, Rebecca, age 2), are living in Livingston, and they are expecting their second child in late June.

In January of this year, **David Vanderscoff** moved to Bismarck, N.D., to become President of

Northern National Life Insurance Co. His wife, Elaine, and children will be joining him later in the year. He recently attained the designation F.L.M.I. (Fellow of the Life Management Institute).

Steve Disman reports he is alive and well in Westchester, N.Y. His wife, Donna, is preparing for her one-woman art show at the Pleasantville Library starting May 28. Any classmates in the area should stop by to say hello. — **Paul Rudovsky**, Secretary, 340 E. 64th St., New York, N.Y. 10021

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Bill Christiansen is Corporate Secretary and Executive Vice-President of Equipment Company of America, a materials handling equipment manufacturer in Hialeah, Fla. At last report he and Terry were expecting their third child. . . . **Greg Zacharias** finally graduated with a Ph.D. in instrumentation from the Institute. He writes that he is suffering from a slight case of "umbilical shearing syndrome" due to his departure from Mother "I" and that his wife Susan is still in shock over the arrival in their home of paychecks. Greg is working with Bolt, Barenak & Newman in Cambridge, and is looking for a house and a chance to indulge in suburban living and the other joys of adulthood.

Gordon DeWitte writes that he is bi-stable, having worked for E.G. and G. three different times and G.E. twice since graduation. For the last two years he has been with E.G. and G. in Los Alamos, N.M. He and his wife have two daughters, Jennifer and Sharon. . . . Susan and **Jerry Tomanek** have a new daughter, Gretchen. . . . Jacqueline Sara Shwimer joyfully announces the arrival of her sister Michelle Sara, born to Elaine and **Joel Shwimer** on November 19, 1977.

Mark Goldman is on the cardiology staff at Massachusetts General Hospital. He, Sara, and two-year-old David are enjoying the relative tranquility of the suburbs. . . . **Pete Denton** has moved to Cherry Hill, N.J., where he is working for the family firm, Denton Vacuum, which manufactures high vacuum equipment and optical coatings. He and Audrey have had a second child, Keith. . . . Jean and **Chet Sandberg** write that their daughter, Kristen Kay, born November 11, 1977, would be great in Las Vegas: she has kept them awake most of the night. — **Jim Swanson**, Secretary, 669 Glen Rd., Danville, Calif. 94526

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This is the final class column circulated before our reunion. We've enjoyed receiving the news clippings these past ten years and passing on items of interest to you, but it will be a special pleasure to see many of you again and to exchange news in the far better fashion a face-to-face meeting allows. Until then, I will pass along the few items in the basket this month and hope that the lack of mail indicates that almost everyone is saving their news to tell us in person.

Our class hero of the month is **Sanford Holst**, who wrote summarizing his activities of the past ten years. From M.I.T., Sanford went to U.C.L.A. for an M.B.A. in finance. While there, he met Carol Benson, whom he married a few years later. Since graduation, he has worked as an engineer, managed a small business, worked for U.C.L.A., and handled financial responsibilities for a technical planning organization; he is currently working for Computer Sciences Corp. in financial planning. During this time, he has also been active in community activities, having been twice elected President of the Beverly Hills Democratic Club, elected to the Los Angeles County Democratic Committee, and appointed to the State of California Democratic Committee. He and Carol — who live on Olympic Boulevard in Beverly Hills — are now the proud parents of a daughter named Suzanne who was born on her mother's birthday, October 8. Finally, Sanford mentions keeping in touch with **Keith and Razel Kallberg**, who are one child ahead of them.

A very special note of thanks go to Gregory

DeWitt ('76), who wrote a long and newsy letter to his class secretary and took the trouble to drop us a copy, since it contained some news about his sister Sue and brother-in-law **Craig Pynn**. After four years in the Navy Seabees following graduation, Craig has been working at Zehntel Corp., a small but rapidly growing company which manufactures computerized testing equipment for electronic hardware (circuit boards, etc.). Craig has been taking evening courses over the past few years, and just finished his M.B.A. at Berkeley last December. He is combining engineering with marketing. Craig and Sue have a two-year-old boy named Geoffrey whom "they are trying to educate fast!" I hope Gregory's thoughtfulness in supplying us this information will inspire other non-graduates to do likewise.

Only two other brief items to report. **Pete and Alexa Sorant** sent an amusing note saying, "Peter is Assistant Professor in the Department of Urban and Regional Planning at Ball State University and plays racquetball in his spare time. Alexa is a part-time instructor in the Department of Mathematical Sciences and has no spare time!" They do have two sons — Christopher (4) and Benjamin (1). Finally, **Scott Marks** reports that he is heading the New York office for Teknekron, a consulting and systems engineering firm based in Berkeley, Calif., working primarily with banks and other financial institutions. He and his wife, Pam, are active in competitive and pleasure sailing on Long Island Sound. He reports, "No kids (yet). Enjoy N.Y.C. and look forward to the tenth reunion in June."

Amen! We hope to see you all there. — **Gail and Mike Marcus**, Secretaries, 2207 Redfield Dr., Falls Church, Va. 22043

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Paul F. Scott has been named manager of the Control Theory and Systems Program at G.E. Research and Development Center in Schenectady, N.Y. . . . **Robert S. Markiewicz** has joined the G.E. Research and Development Center in Schenectady as a physicist.

Robert Swanson is involved as President with Genentech, a company which apparently, according to an article in the *San Francisco Chronicle*, is attempting to patent the process used to produce the hormone somatostatin in E. coli bacteria. Genentech's Vice President explained why the company is trying to capitalize on the basic research technique involved in recombinant DNA technology thusly, again according to the *Chronicle*: "I wanted to see that the technology gets transferred to private industry so that public benefits come out as soon as possible."

That's all folks — **Peter Peckarsky**, Secretary, 950 25th St., NW, Washington, DC. 20037

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In an article appearing in *Newsweek* this winter, **Greg and Karen Wattel Arenson** were mentioned with respect to their means of accommodating their careers. After Greg completed law school and embarked upon his legal career in Chicago at the expense of Karen's job opportunity, they moved to New York so that Karen could work at the headquarters of *Business Week*.

James Widtefeldt received his Ph.D. in mathematics at Rensselaer Polytechnic Institute and now is completing his third year of law school at the University of Nebraska. . . . **Richard Tavan** is a senior systems engineer at MASSTOR Systems Corp. in Santa Clara. . . . **Antonio Vila** is Assistant Vice President and Assistant Actuary at American Bankers Life Insurance Co. in Miami. He and Manola have a five year old son. . . . **Howard Bluestein** is continuing to study severe thunderstorms and has filmed a tornado from a distance of less than one mile. Evidently, he was able to record the explosions that occur in the vortex of the tornado.

Steve Cooper is in private medical practice as a free-lance anesthesiologist. He has visited **Larry Griffith**, who is Assistant Professor of Mathema-

tics at the University of Missouri at St. Louis. . . . **Frank Pompei** resides in Natick and is Vice President of Marketing at Scientific Energy Systems Corp. **Jack Liu** has been with Dynamics Research Corp. in Wilmington for over a year, where he is involved in problems of detection and reliability in aerospace energy and environmental systems. Jack married May Chao, sister of Donald ('73).

In March, **Fred Campling** completed his first year as an Assistant Crown Attorney (Prosecutor) in Hamilton, Ontario. The previous year was spent as a law clerk to the Supreme Court of Ontario. He and Cynthia, his spouse, attended the wedding of **Ron Eisinger**, who is with Ford, and saw Vince Fazio, '71, who was with General Motors until entering the Ph.D. program at the University of Illinois. . . . **Nancy and Ralph Albanese** became parents of their son, Ralph. . . . **Earl Withycombe** is spending at least part of his time as a partner and general manager of Sierra-tech Associates, a small civil engineering firm.

Richard Freyberg and Rich Thurber ('67) started Freyberg Systems Associates, Inc., computer systems for large financial institutions, and are starting a European branch. . . . **Glennard Ruedisueli** opened his medical practice in Derry, N.H., after his pediatric residency in Columbus, Ohio. . . . **Harvey Schultz** and his spouse, Jacqueline, became parents of Ethan Michael in November. . . . **Steven K. Gregory** is completing work on his Ph.D. in computer science at the University of Utah and has accepted an appointment as Assistant Professor in the Department of Architecture at M.I.T. Steven has been Director of Utah's Computer-Aided Design Laboratory.

The Tao of Physics by Capra is recommended to classmates by **Peter Marmorek** as good reading. He says that being an educator in an alternative high school in Toronto is very exciting.

. . . **Anthony Picardi** and his wife spent their free time building a new gambrel cape house in Wellesley, completed Thanksgiving. He is continuing in water and power planning for Saudi Arabia, while his spouse is in M.I.T.'s Industrial Liaison Office. . . . **Thomas Derby III**, writes that he is Vice President and Director of Marketing for International Energy Conservation Systems, Inc., the South's largest energy management network. Their son, Tom IV, may be a "Tool" like his father. Unfortunately, Tom's father, T. H. Derby, Jr., ('43), recently passed away. He entered M.I.T. at age 15 and graduated three years later.

Maggie and I have been traveling for seminars and on business; we took our son, Sean, to San Francisco in April. — **Robert Vegeler**, Secretary, 2120 Fort Wayne National Bank Building, Fort Wayne, Ind. 46802

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Ronald L. MacNeil has been promoted from instructor to assistant professor. Ronald, who received an M.F.A. from the Rhode Island School of Design, received the Massachusetts Arts and Humanities Foundation Artist in Residence Grant in 1976, and was with the Minor White Creative Photography Program in Rochester, N.Y. . . . **James L. DeLucas** will finish medical school at the University of Alabama in May, 1978, to begin a three-year residency in family practice at Eglin A.F.B. Medical Center in Fort Walton Beach, Fla. . . . **David Laing** is still alive and ticking.

Congratulations are due to **Avi Ornstein** and his wife Bernice who are the parents of a daughter, Satya, last May. He writes that Sandy and **Bern Krafsig** have their second daughter, Katherine Michelle, on the same day. . . . Our class is beginning to produce: **Daniel Weinberg** and his wife, Page R. Laws, announce the birth of their son, Garrett Jesse Laws Weinberg, on November 3, 1977 (8 pounds, 9 ounces). Daniel is an economist at A.B.T. Associates in Cambridge.

Andrew H. Sims, Jr., is City Engineer for New London, Conn., a job without big city commuting. He is an education council member having interviewed some 25 prospective M.I.T. students. . . . **D. Griffin** has "hit the solid middle class" by purchasing a house in suburbia and working for the same company (Hewlett-Packard) for over five

years. . . . **Thos Tate** is now with Amdahl Corp., working on the I/O processor for a large computer after receiving his master's in electrical engineering from Stanford in 1976.

Michael J. Frankston is a finalist in the selection process for space shuttle astronauts. He is one of 208 persons chosen from among 8,000 applicants. . . . **Jerry Kardas**, 1402 Terra Nova Blvd., Pacifica, Calif. 94044, would like to hear from old Burton Four and McGregor "A" people (**Scott Stricoff**, **Ev Sinnett**, **Harlan Chizen**, '72, et al.) and from **Linda Getch**. Jerry writes, "Jan (Wellesley, '71) and I moved from Connecticut to the Bay Area. I transferred from Pratt and Whitney Aircraft to the Chemical Systems Division of United Technologies, and Jan continued her Ph.D. work in ethnomusicology at University of California, Berkeley after completing her M.A. at Brown University. We joyously welcomed the birth of our daughter Ellen on January 21, 1977. She has brought a wonderful new dimension to our lives. We now live a few miles south of San Francisco, one mile from the ocean and two miles from the San Andreas fault. Weekend hiking and the snow and sources of recreation for us. My current work involves the development of technology related to ramjet propulsion systems for high speed aircraft and missiles. Jan plans to take her doctoral exams in early 1979."

Mike Gilmore writes, "I have recently returned from a six-month trip around the world. Highlights included having a rented Datsun semi-charged by an elephant and spending a night in a Masai village in Kenya, seeing eight of the ten highest peaks in the world in a morning sightseeing flight in Nepal, visiting the Pyramids, the Taj Mahal, and the Coliseum, and going through the Prado in Madrid. Lowlights were getting ripped off in Italy, severe illness in Kathmandu, the French vestiges of British colonialism, and missing the football season." . . . **Chris Marler** former Deke, is now D.P. Operations Manager of International Harvester's Corporate Computer Center, Hinsdale, Ill. He now is the father of three girls. The newest, Joan Phyllis, was born September 27, 1977.

Gus J. Vlahakes writes, "I am completing my third year of surgical residency at Massachusetts General and will be a research fellow at the Cardiovascular Research Institute at the University of California, San Francisco this July. Eleven years is a long time in Boston. A change of pace for a couple of years will be welcome, but alas, return to Mass. General in 1981." It can't be that bad. . . .

Matthew Becker and his wife Elaine announce the birth of their son Joshua Michael, born May 16, 1976. Matthew is finishing up his residency in anesthesiology at Duke and will be in a fellowship in pediatric anesthesiology and respiratory care next year at the Children's Hospital, National Medical Center, Washington, D.C. . . . **Mark Van Note** was recently appointed coordinator of Mental Health Services of Southeastern Vermont's Day Treatment Center in Bellow Falls, Vermont. Mark earned an M.S. in occupational therapy at Boston University and has been activities director at North Dorchester Community Day Hospital, part of Tuft's New England Medical Center Department of Psychiatry.

Bob Lada is cleaning up in poker and his new job in computers at Polaroid. . . . Since last time, I attended a week long seminar for trial lawyers sponsored by the State Bar of Texas. Chief Justice Burger exaggerates when he says over half the practicing trial attorneys are incompetent.

Soon the bluebonnets will be covering the hillsides. Please cover my mailbox with your letters. — **Hal Moorman**, Secretary, P.O. Box 1808, Brenham, Tex. 77833

72

News is a bit sparse this month, but here goes. **John Gunther** is Engineering Systems Manager for Facilities Planning and Construction at the University of Alaska in Anchorage. . . . **Fritz Yohn** is completing his Ph.D. in economics at Princeton and working at the Federal Reserve in Washington, having married Christine Price, a Wellesley graduate. . . . **Donald Hewitt** left the army in Jan-

uary to become a Program Development Manager for the Computer Science Corp. in Falls Church, Va.

Alfredo Sadun writes, "I have finally reached an end to my New York tribulations, having obtained my Ph.D. in neuroscience last year and my M.D. this year while at Einstein in the Bronx. With great delight I shall be returning to Boston to do a residency at Mass. General. I'll see if I can sneak into some M.I.T. intramural football games."

Janet Lantner reports that she left Boston Edison to become Assistant Project Engineer for the El Segundo Station of Southern California Edison. She got her M.S. and P.E. license last year and hopes to continue work on a Ph.D. in mechanical engineering. Her husband Gary, '71, is Manager, Properties, for Continental Airlines in Los Angeles. — **Dick Fletcher**, Secretary, 135 West St., Braintree, Mass. 02184

73

Greetings to all from this end. A fair bit of news to report. **Lewis Held** received a Ph.D. in molecular biology at U.C. Berkeley, and is now doing post-doc work on *Drosophila melanogaster* (1967) development at the Center for Pathobiology at U.C. Irvine. . . . **Rich Schechter** has begun working for the Engineering Research Division of Lawrence Livermore Labs, living in San Lorenzo, Calif.

Phil Sikes is employed as a chemist in the metal department of Maynard Steel. He will complete a master's in Electrical Engineering at Marquette in the spring of this year. Phil is looking for employment as a biomedical engineer. . . . **William Stohl** married Aviva Simon (Barnard, '73) in August, 1974. They are proud parents of Sheldon M. ('98) since September 28, 1976. Bill received his M.D. from Penn last May and is working toward an immunology Ph.D. there.

Bill Blum writes from Harrisburg, Penn., to say that he graduated from B.U. Law School in June and works now for the Pennsylvania Public Utilities Commission as a member of the prosecutory staff for public utility rate cases. . . . **Lawrence Fagan** is two-thirds of the way through a Ph.D. in "Computer Applications in the Intensive Care Unit" at Stanford's computer science department. . . . **Valerie Murdza Daniel** moved to Natick last fall with her husband and son. She has her hands full with that and her free-lance work. (The '72er who passed that along neglected to say as a what.)

Paul Bayer writes that his wife Terry gave him a son December 29, who is keeping him from oversleeping. Andrew's ('00) pa hopes to finish his Ph.D. in computers and exit the 'Tute (finally) in August. "I don't think I can come back for the reunion, because I never left!" quoth he. He continues to look forward to hearing from me monthly. Bless his heart. Are you listening, TR?

Yours literarily is busy tuning his T.V. set for the advent of Opening Day at Fenway (Go, Sox!) or to see if they'll let me sing the anthem again. I heard from Tony Scandora con telefono to say he'd be in town shortly. But since nobody remembers him, what's the difference? See you in a month. — **Robert M.O. Sutton**, Secretary, 37 Fairbanks St., Brighton, Mass. 02135

75

Via the Alumni Fund, I've heard from the following people: **Leo Katzenstein** is still a graduate student in math at the University of Chicago. . . . **Loren Dessonville** will graduate from the University of Chicago Law School in June and will immediately begin work in the Omaha office of Kutak, Rock and Huie. . . . **Martha J. Donahue** says she is "happily settled into my new job and home at Hanscom A.F.B., just 15 miles out Route 2 from M.I.T. I like the Air Force life, and get to use some of my M.I.T. training as a program analyst for several development programs." . . . **John Stern** is working for Ampex in Redwood City and attending Stanford for a Ph.D. in E.E. . . . **Mark D. Beasman** wrote, "Having graduated from the Tuck School of Business (at Dartmouth) with an M.B.A.,

I am now with the consulting staff of Arthur Anderson and Co. in Boston. I'm still in touch with several members of '75. **Tom McKim** is completing his third year of law school at Chicago University, and **Nick Davis** is doing graduate work in Course III at the Institute."

I must thank Gregory S. DeWitt, '76, for sending me some information about some of our classmates. In his travels around California, Mr. DeWitt saw or got in touch with: **David Dix** who is working on his M.S. in computer science at Berkeley; **David R. (Sam) Martin** who apparently is enjoying his first year at Stanford Business School after having spent the summer after graduation in Washington, D.C., working at the Congressional Budget Office; **Jia Shu** who is a graduate student in computer science at U.C.L.A.; and **Jeff Diercks** who is going to a Christian seminary school in Altadena and is now married.

I'd like to wrap this up with a report from my regional representative in the New York area, **Tom Hui**, who is in his third year at N.Y.U. Medical School. Tom writes that **Barbara Freeman, Dong Park**, and **Bill Ntoso** are all in various stages of the third year in medical school at Mt. Sinai and Albert Einstein. . . . **Carol Livingstone** is now married and is a graduate student in neurophysiology at Columbia University. . . . **Noreen Hickok** and **Karen Seo** are currently sharing an apartment in Madison, N.J., and are both working in northern New Jersey. . . . **Alwin Okuna** and **Sue Tsang** are living and working in the San Francisco area. . . . **Iwan Hirsan** married **Denny Leung** last summer and they are now living in Chicago. . . . **Boucar Djermakoye** just received his engineer's degree in Electrical Engineering at M.I.T. and is now a research affiliate at the Institute. . . . **Anna Shen** is in graduate school at the University of Wisconsin, Madison, studying pharmacology. She says the winters are very cold but enjoys the opportunity of skating on a small frozen lake near her apartment. . . . **Koichi Kodama** has been working for Shell Oil Co. in Houston, Tex., for the past three years. He is involved with the process engineering and plant design of some of Shell's manufacturing plants. He enjoys the Texas weather and sun. . . . Finally, **Salvador Caro** is a graduate student in chemistry at the University of Karlsruhe in West Germany. He hopes to receive his Ph.D. sometime in 1979. Thanks for the news, Tom.

That's all for now. Please write if you get the chance. — **Jennifer Gordon**, Secretary, 22 Centre St. #9, Cambridge, Mass. 02139

76

From the mails, I have a goodly amount of news. Hurrah!

Gikas Mageras writes that he is a good student at Berkeley. . . . From **Edward Capparelli**, an interesting note: "I am currently a third-year medical student at Mt. Sinai Medical School, and am enjoying finally working with patients. I am still doing a great deal of work in Central America and have just returned from Nicaragua where I was a public health director for five Indian villages." . . .

Gregory Allen reports that he is in his second year of medical school at Washington University, St. Louis. Furthermore, he is the only person from M.I.T. in his medical class. . . . **Sam Gasster** is presently a grad student in theoretical physics at Berkeley. He "hopes to get a Ph.D. one of these days!"

Norma Shepperd (nee Chinn) has written me a letter at last. Norma reports that she got a master's in interdisciplinary science — half in management, half in food and nutrition. Then, on June 11, 1977, she married Stanley Shepperd, M.I.T. '70. Among the people at her wedding in New Jersey were **David Anick**, **Martha Donahue**, and **Dan Jablonski**. She reports that she has found a job with the John Hancock Insurance Co. as a computer programmer! She works a four-day week, and her "three-day weekends every week are great." The career change is welcomed — "I've decided that now that my job is in another field, my hobby will be food and nutrition. I think it will work out well."

From **Bob Struth**, a brief letter. He is in Pensa-

ola, Fla., in training to be a Naval Flight Officer in Jet Fighters and will probably get his wings when this column appears. He reports, "I'm flying and that's what I love best." He also has a greater love these days, for on June 10 he will marry Donna Davies, a native of Pensacola. He writes that she teaches 9th grade English at the high school, and is a graduate of University of West Florida. Their honeymoon plans include St. Moritz, Switzerland; Innsbruck, Austria; and Munich, Germany. Sounds like a fine way to start!

David August has written. He reports that he is at Yale Medical School and is working quite hard, even though Yale has a no tests/no grades system. He reports that, "there isn't much pressure. I'll be starting my clinical rotations in July, and can't wait. Among our classmates here are **Leon Sweer** and **Lila Inouye**. Both are happy and doing well. . . . My most recent hobby has been marathon running." He sends us word that **Larry Parker** is out in Oklahoma getting his Ph.D. in political science, and teaching. He also requests any classmate to please send any news or whereabouts of **George Economou**, his freshman year roommate. If anyone knows, please drop me a line and I'll send it on to Dave.

I have a delightful, long letter from **Gregory DeWitt**. He is a grad student at the University of Illinois at Urbana-Champaign in the physics department. From Christmas on, he has done some traveling, spending time in L.A. and Hawaii, and skiing in Colorado. He teaches, and is doing so well that the students rated him excellent, putting him in the top 20 per cent of the T.A.'s of the course. Last August he passed his qualifying exam, and has been elected to the Graduate Student Advisory Committee. Also, his softball team won the graduate league championship, thus giving him cause for a tremendous celebration. Career-wise, Gregory is thinking about computers and nuclear physics, preferably with a job straddling both teaching and industry. This summer he hopes to obtain work in industry.

Gregory reports that **Gig Mageras** has passed his prelim exams for his Ph.D. in particle physics and **Ken Yasuda** got an M.S. in mechanical engineering from Berkeley. Ken's new job puts him in Mountain View, Calif., and he is working on solar energy and numerical studies associated with it. **Bob Blau** is finishing his thesis for an M.S. in computer science at Berkeley. He apparently wishes to work for Hewlett-Packard. **David R. "Sam" Martin** is finishing his first year at Stanford Business School and he likes it. Gregory quotes Sam, "There is a difference here . . . you have to keep up, because you might get called on . . . not like M.I.T., where you could study the night before the test. A lot of people here are not so good at the math, so the quantitative courses are relatively easy for me. The courses that involve a lot of reading are a little more difficult. I wouldn't say the students here are any brighter (than at M.I.T.), but . . . they have something (else). . . . They know how to get things done." **Jia Shu** is a grad student in computer science at U.C.L.A., and he told Greg that the program he is interested in is "only starting, and just great."

Last issue, if you remember, I intimated that I have run into a bit of difficulty, career-wise. That is correct. I have had a peculiar experience. I was Associate Director of Research at Lloyd, Carr and Co., a commodity option brokerage house. Was, that is, until the F.B.I. arrested my boss, James A. Carr. It turns out that his real name is Alan H. Abrahams, an escaped convict. In the three years since he escaped from a prison farm in New Jersey, he managed to build a brokerage firm, which, at its peak, did the equivalent of \$66 million per annum in business. As to my role, I am afraid I must defer making any lengthy report on the advice of my lawyer, until the flurry of lawsuits and investigations is over. After all, how many escaped cons on the lam become business tycoons. I can tell you that his 900 to 950 employees, coast-to-coast, including myself (I reported directly to Carr/Abrahams in the corporate chain of command), were shocked, among other things. It has been an experience for me, as I have had a chance to watch dirty political fighting by a federal regulatory agency (C.F.T.C.) against

a business, to see another federal agency (F.B.I.) used, for among other things, intimidation when they have no legal course of action, and a host of other abuses at the state level. I know these charges are serious, and I believe I can give more than adequate examples of such occurrences.

As for my future, it is unclear at the time of submission of these Notes. I have gotten a license as a Commodity Trading Advisor, and am seeking to form my own company, a Commodity Pool Operation (not a brokerage firm). A C.P.O. is analogous to a Mutual Fund, except that it trades futures (not options on futures) in managed accounts. I expect my firm to be able to get the C.P.O. license, but capital remains a problem. I am working on it.

These events have left your secretary with a cynical view towards certain areas of state and federal government. Please write, for I cannot always supply even sensational news all by myself. — **Arthur J. Carp**, Secretary, 67 Badger Cir., Milton, Mass. 02186

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Well, I'm back once again after a lapse of a couple of issues and hope to maintain a constant flow of information from here on. The response to my impassioned plea for news has been tremendous, with letters coming in from all quarters. If you haven't written yet, it takes only a few minutes to jot down a few lines.

Al Knauf is currently at the University of Michigan Law School in Ann Arbor along with **Steve Weisberg**, **Dave DeBruin**, and **Chris Donnelly**. **Randy Perez** is also in scenic Ann Arbor hard at work in the chemistry department and has occasionally encountered **Lester Weitman** and some of the former Bakerites mentioned above. . . . **Steven Hoffman** is alive and well and earning his keep in the Process Engineering Department of Shell Oil, Co. His primary duties include design work for several new industrial and agricultural chemical plants. . . . Rutgers Medical School has at least one happy first-year student in Peter Rives. He writes, "Only now do I see to what a great extent I have benefited from my M.I.T. experience." I'm certain he's not alone in that mode of thinking.

When I manage to make it to class on time, I usually share a T bus ride with **Sue Stewart** who is working in David Botstein's lab at M.I.T. as a technician. . . . Another person still at M.I.T. is **Alexander Ling** who began the health sciences and technology program this year. . . . **Brian Raila** is living in Allston and has been working for Project Partner in Wenham as their film-maker in residence. The program is aimed at developing lesson materials for teachers and uses various art forms to augment the traditional language arts.

Mark Vincent is at Carnegie Mellon University in the M.B.A. program there. . . . **Scott Feldman** is at Arthur D. Little, Inc. doing work on a solar/lead management project. . . . Out in San Diego working for General Dynamics/Convair is **Tom Coradetti**. He's been programming computer simulations of large flexible spacecraft. Headed out to that same area is **Steve Keith**. Commissioned as an ensign in June, he's in the Navy's nuclear propulsion training program which he will finish in August. At that time Steve will join the fleet in San Diego. . . . In San Francisco on February 20, **Joe Schneider** married Nancy Bell ('75). Joe is in the Navy and Nancy is working for Bechtel. . . . **Bill Kaiser** is working for Hewlett-Packard in Sunnyvale in their sales division and sailing and flying a great deal of his free time.

I think I'll end on that high-flying note, since that's about all the news I have right now. If an aardvark happens to eat your favorite petunia, or even if something a little less mundane occurs, feel free to drop me a line telling me about it and it'll show up in the next set of class notes. — **Doug McLeod**, Secretary, 11 Silvey Place #1, Somerville, Mass. 02143



Near-Strangers to FORTRAN Turn Into Championship Computer Programmers

Daniel D'Eramo, '80, had never written any FORTRAN programs. And Abraham Lederman, '80, Lawrence DeMar, '79, and Curt Sanford, '80, hadn't worked on FORTRAN "for a long time." None was a member of the student chapter of the Association for Computing Machinery or the Student Information Processing Board.

But Mr. Lederman thought it would be fun to enter A.C.M.'s Student Programming Contest, and the other three "just went along." "Basically we spent one night studying" before the Northeast Regional Contest at Rensselaer Polytechnic Institute late in January — and the four students surprised everyone by completing three out of four problems in less than two and a half hours. The fourth one took a little longer, but the team ended up with a 28-problem/minute

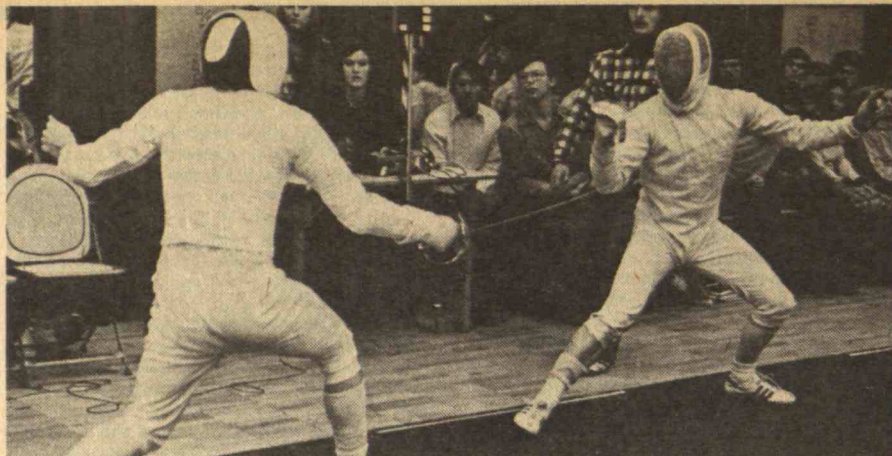
edge over Worcester Polytechnic Institute.

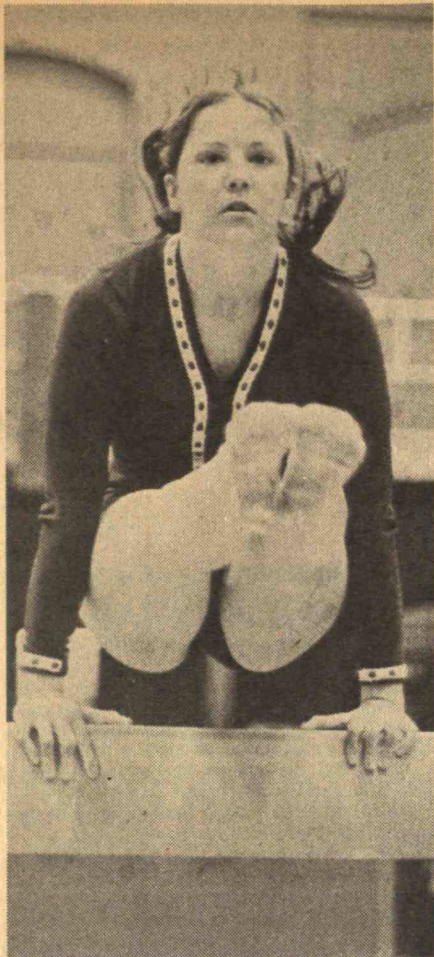
That meant a trip to the national convention of the Association for Computing Machinery in Detroit, for which the four students obtained financing from the Dean of Engineering and the Department of Electrical Engineering and Computer Science.

There it was the same story all over again: the four — all residents of Baker House — conquered countless keypunch inadequacies as well as two out of four programming problems to become the A.C.M.'s national champions. Only two of 24 teams at the national convention solved two of the four problems in the contest, and M.I.T. was faster than runner-up New York University. Other winners — with one problem to their credit — were Michigan State and Purdue Universities. A fifth-place prize went untaken: no other team had even one right answer after nine hours of trying.

If you see a T-shirt that says "Food Barn," you're probably seeing a resident of Baker House. And you may also be seeing a grand national computer programming champion. These four students entered the Association for Computing Machinery's Northeast Programming Championship because no one else at M.I.T. seemed interested in a FORTRAN-based competition; a win there took them to the national A.C.M. convention in Detroit, and from there it was a short trip home as national collegiate computer programming champions. Left to right: Curt Sanford, '80, Lawrence DeMar, '79, Abraham Lederman, '80, and Daniel D'Eramo, '80; all are students in the Department of Electrical Engineering and Computer Science. (Photo: Calvin Campbell)

Winter sports news in 1977-79 was dominated by two names: Preston Vorlicek, '79 (right), broke two M.I.T. breaststroke records during the regular season and then made All-American by taking sixth in the 200-yard breaststroke at the N.C.A.A. finals. Last year he finished eighth in the same race. Leslie Harris, '81 (opposite page) is the first woman athlete from M.I.T. to win All-American. She did it by taking fifth on the uneven bars at the national women's gymnastics championships at the Air Force Academy; she was undefeated in the all-around gymnastic event during the regular M.I.T. season. (Photos: Gordon R. Haff, '79, and J. Robert Mitchell, '78, from The Tech)





Students and Faculty: A Growing Sense of the Collegiate Battlefield?

By William Lasser, '78

"When I was an undergraduate," alumni seem fond of saying, "Tech was hell." The implication is that it isn't any more. Yet many current students are concluding that those who determine academic policy are trying to make M.I.T. at least a bit more like purgatory.

Less than a month after the faculty yielded to student pressure and refused (by two votes) to move the drop date to the fifth week of the term (see page A10), students found themselves confronted by a report of an Ad Hoc Committee on Grading. For all its carefully-worded language, it was interpreted by undergraduates as an attempt to bring about what has come to be known as "grade deflation."

Most students are disconcerted. Faced with ever-spiraling tuition and living costs coupled with discouraging job prospects, they need increased academic pressure less than Napoleon needed Waterloo. In the current vernacular, students feel personally "screwed by the Institute" — an expression which has replaced the antiquated "Tech is hell" and which reveals a distressing trend: more and more, students feel the need to blame someone in particular for problems which have always existed, be they academic, financial, social or personal.

On several fronts, frustration and a growing sense of mutual distrust between students and faculty have placed the two groups on opposite sides of the collegiate battlefield. At the same time it rejected the drop date move, the faculty irked students by canceling a scheduled February vacation to make up for days lost to the Blizzard of '78. Charges that the Committee on Academic Performance has been "cracking down" on students in the past few years were refuted by C.A.P. Chairman Thomas Greytak, '62, Associate Professor of Physics, in the campus media. A committee appointed to investigate the Institute's relationships with United States intelligence agencies was left devoid of a student representative, stirring significant protest. And, of course, students are unjustly blaming the administration for the all-but-unavoidable cost increases which make M.I.T. one of the most expensive schools in the country.

Nonetheless, many of the students' complaints are entirely understandable: on several issues, the faculty and the administration have acted in a manner insensitive to the needs and desires of students. On the grading and drop date matters in particular, student leaders have accused the faculty of adopting a patronizing attitude which further heightens the antipathy. Students feel betrayed by professors who fail them as advisers and then vote "against them" in decisions of academic policy or, worse yet, re-

fuse to even attend faculty meetings.

The national press has been filled with stories asserting that today's college students are apathetic, apolitical scholars whose primary concerns are personal and economic. Indeed, there seems little likelihood that M.I.T.'s undergraduates will rise up in mass protest. The outer calm, however, reflects at best a student population resigned to a position from which they feel they can neither escape nor effectively challenge the forces opposing them.

Dean for Student Affairs Carola Eisenberg, in a persuasive and widely admired speech to the faculty before the drop date vote, saw through the politicized thicket to the key point. "My primary objection to the change in drop date," she said, "is its symbolic significance to the students. It will be read as a sign that we don't have confidence in their ability to make choices." What M.I.T. needs is not tougher academic standards — they are tough enough already and are widely regarded as such — but a new commitment to the involvement of students in the vital academic policy decisions ahead.

William Lasser, '78, was Editor-in-Chief of Volume 97 of The Tech — one of the most effective of a long line of distinguished campus editors. He'll pursue graduate study in government at Harvard after completing bachelor's degrees in political science and chemistry at M.I.T. next month.





D. Roos

Roos to Head Transport Studies

Daniel Roos, '61, Professor of Civil Engineering who is the author of the Computer-Aid Routing Systems (CARS) for dial-a-ride and dial-a-bus services, will be Director of the Center for Transportation Studies effective July 1. He'll succeed Professor Paul O. Roberts, the Center's first Director, who will devote full time to teaching and research.

According to James D. Bruce, Sc.D. '64, Associate Dean of the School of Engineering, one of Professor Roos' first assignments will be to develop formal graduate programs in transportation. He'll also seek to develop studies encompassing technology as well as policy affecting transportation.

Professor Roos joined the M.I.T. faculty in 1966 to work with an Integrated Civil Engineering System (ICES) as Director of the Civil Engineering Systems Laboratory. His interest in innovation in urban transport is reflected in his work on CARS and in his service as Chairman of the Committee on Urban Transport Service Innovation of the Transportation Research Board.



J. L. Kinsey

James Kinsey Heads Chemistry

When Professor **John M. Deutch**, '61, went to Washington to become Director of Energy Research in the new Department of Energy (see *March/April*), Professor James L. Kinsey became Acting Head of the Chemistry Department. Now he's Department Head.

At M.I.T. since 1962, Professor Kinsey is an authority on atomic and molecular interactions, and a specialist in molecular beam research and chemical kinetics. His degrees are from Rice University, and he did postdoctoral work at the University of Uppsala, Sweden, and the University of California, Berkeley, before joining M.I.T.

Courses

Civil Engineering

Frank E. Perkins, '55, Head of the Department, is Chairman of the Federal Dam Safety Independent Review Panel; named by White House Science Adviser Frank Press, the Panel will review regulations, procedures, and practices of federal agencies as they pertain to dam safety. Professor **Erik H. Vanmarcke**, Ph.D. '70, is among ten panelists.

George Bugliarello, Sc.D. '59, President of the Polytechnic Institute of New York was a speaker at The Conference on Technology and Business Futures at the University of Southern California in March. . . . **Roger A. Hadley**, '65, is a Major in the U.S. Air Force currently assigned at the Headquarters for Strategic Air Command at Offutt A.F.B., Neb. He is working as a structural consultant for the Command which has 28 bases to support.

Materials Science and Engineering

Nicholas J. Grant, Sc.D. '44, ABEX Professor of Advanced Materials, is Chairman of the U.S. scientists involved in a U.S./U.S.S.R. Working Group for Materials and Electrometallurgy. Frank Press, Science Adviser to President Carter who named Professor Grant, hopes the U.S.-U.S.S.R. discussions will lead to shared programs in research and exchanges of specialists between the two countries. Among some 40 U.S. scientists who will work with Professor Grant are four members of the Department of Materials Science and Engineering: Professors **Thomas B. King**, **John F. Elliott**, Sc.D. '49, **Merton C. Flemings**, '51, and **Julian Szekeley**.

Chemistry

Virginia R. Cross, Ph.D. '76, is Research Chemist at Celanese Plastics Co., Greer, S.C. Her husband, **John P. Cross**, '72, works as Research Chemist at Milliken Research Corp., Spartanburg, S.C. . . . **Kenneth D. Jordan**, Ph.D. '74, was awarded a \$35,000 grant from the Dreyfus Foundation in New York for research in chemistry. He is Assistant Professor of Engineering and Applied Science at Yale University, and is one of 16 scientists selected nationally to receive the grant. . . . **Frank Vellacio**, Ph.D. '74, Professor at Holy Cross College, has received a \$6,000 science grant from Cottrell College to support his research on protein growth. . . . **Edward M. Barrall II**, Ph.D. '61, co-authored the article, "Data Acquisition and Reduction Program for Thermogravimetry," in the January issue of the *IBM Journal of Resource Development*.

VI

Electrical Engineering

To **Harrison E. Rowe**, '48, of the Radio Communications Research Department at Bell Laboratories, Crawford Hill, Holmdel, N.J., the David Sarnoff Award of the Institute of Electrical and Electronics Engineers. The Award, for outstanding achievements in electronics, was for work "on the properties of nonlinear devices resulting in the well-known Manley-Rowe Relations"; it was shared with Jack E. Manley, formerly of Bell Laboratories who is now teaching at the University of Wisconsin.

Awards of the grade of Fellow in the Institute of Electrical and Electronics Engineers to:

□ Professor **Jonathan Allen**, Ph.D. '68, "for contributions to the design of computer architecture for signal processing and to the synthesis of speech from text."

□ **Jerome Freedman**, Assistant Director of Lincoln Laboratory, "for contributions to the development of radar systems."

□ Professor **Frederic R. Morgenthaler**, '55, "for contributions to the theory and applications of microwave magnetics."

□ **Charles M. Rader**, Assistant Group Leader in Spacecraft Communications Processors at Lincoln Laboratory, "for contributions to digital signal processing."

□ **Ernst F. R. A. Schloemann**, '55, Research Division, Raytheon Co., "for contributions to the theory and development of microwave ferrite materials and devices."

□ **Charles A. Zraket**, S.M. '53, Executive Vice President and Director of Mitre Corp., "for technical management and contributions in the application of systems engineering to large military and civilian problems."

Charles Zraket has also been elected to member of the Board of Trustees of Mitre. In addition to his corporate responsibilities at Mitre, he is Chairman of an Advisory Committee on Management Information Systems for Massachusetts Governor Michael Dukakis and Vice Chairman of Virginia Governor Mills E. Godwin's Council on Transportation.

Christopher Strangio, S.M. '76, is teaching the course, "Introduction to Microprocessors," for the Boston section of the I.E.E.E. He is also an instructor at the Lowell Institute School and has founded CAMI Research of Watertown, Mass., an engineering consulting firm for digital system design and microprocessor applications. . . . **David R. Cuddy**, S.M. '74, is working in the Speech Research Dept. of Bell-Northern Research, Ottawa, Canada. . . . **Stanley R. Robinson**, S.M. '75, is Assistant Professor of Electrical Engineering at the Air Force Institute of Technology, Wright-Patterson A.F.B., Ohio. He teaches graduate courses and does research in the area of optical communication and imaging systems for Air Force applications. He received the U.S.A.F. Research and Development Award in 1977 for work in the design of Air Force electro-optic systems.

VI-A

Cooperative Program in Electrical Engineering and Computer Science

Motorola, Inc. was welcomed to the March VI-A Selection Program as the latest firm to join the Electrical Engineering and Computer Science Department's highly successful program. Associate Dean **James D. Bruce**, '60, will be Motorola's first VI-A Faculty Adviser. **Lewis H. Rosenthal**, '73, who is on the staff of the Communication Division, presented the VI-A Company Talk for Motorola.

VI-A selects its 61st class this spring. Our program's popularity continues this year with the receipt of 141 applications for admission. The participating companies expect to have 75 new openings for this year's VI-A class (comparable to the past several years). Current enrollment in the VI-A Program, including juniors, seniors, and graduate students, totals 188 — an all-time high!

The Hewlett-Packard Co. is also expanding their participation this year. They will have new positions in their Optoelectronics Division and the Integrated Circuits Laboratory of Corporate Research Labs, both located in Palo Alto, Calif.

All company representatives gathered on campus, March 6, for the annual VI-A Business Dinner and Open House. Close to 300 applicants, currently enrolled VI-A students, faculty and company representatives attended this year's Open House.

The two ensuing selection days saw a total of 739 interviews conducted by the participating companies. It will take Director Tucker about seven weeks of conferences with the selected students to complete the enrollment of the VI-A Class of '78.

Philip B. Giangarra, '76, has joined the Newport, R.I., Laboratory of the Naval Underwater Systems Center where he interned as a VI-A student. Phil returned to the campus to help with N.U.S.C.'s presentation. . . . **Thomas E. Knight**, '74, is working in the Large Computer Group of the Digital Equipment Corp., Marlboro, Mass. He and his wife, Susan, live in Wellesley. . . . **Jeffrey R. Long**, '74, is with the Radar and Digital Systems Division of Equipment Group, Texas Instruments, Inc.

A letter from **James T. Walton**, '76, brought us up to date on his activities. Jim decided to complete his service obligation and is stationed at Fort Gordon, Ga. He is with the Concepts and Studies Division, Directorate of Combat Developments, which analyzes the requirements, feasibilities, and cost-effectiveness for the Army regarding communication systems and proposals. He told us that **Jeffrey A. Grossman**, '76, is in his same unit but assigned to a different project.

We have received many nice comments on our "Newsletter." Your continued cooperation is needed, however, to keep it going so please send any interesting items to: M.I.T., VI-A Office, Room 38-473, Cambridge, Mass. 02139 — **John A. Tucker**, Director.

A Lifetime of Cancer Research to Phillips Robbins as Cancer Society Professor

Phillips W. Robbins, who came to M.I.T. as Assistant Professor in 1959, has been named by the American Cancer Society to be A.C.S. Professor of Biochemistry. During 18 years between now and Dr. Robbins' retirement, the Society will provide \$551,490 toward his salary and research support.

Through grants such as this, the Society wants to assure "the existence of a free and independent body of scientists" dedicated to solving problems related to cancer, says Dr. John W. Turner, President of the American Cancer Society's Massachusetts Division. "Scientists must be free to develop theories, test their theories in the laboratory, and discard their theories when new facts demand it.

"Without this freedom, cancer research would come to a standstill," says Dr. Turner.

Using his new endowment, Dr. Robbins will make a "lifetime study" of the structure, function, and synthesis of human cells, seeking especially differences between normal and malignant structures. He's trained in biochemistry at DePauw University and the University of Illinois and came to M.I.T. after work at the Rockefeller University and Massachusetts General Hospital.

In addition to teaching and research responsibilities at M.I.T., Dr. Robbins heads the Cell Culture Center, producing cells required for biological experiments by scientists at many institutions throughout the U.S.

Dr. Robbins' is the second American Cancer Society Professorship at M.I.T.; the first was given in 1973 to David Baltimore in the field of microbiology.



P. W. Robbins

Two Engineering Department Heads Returning to Classroom and Laboratory

Two Heads of Departments in the School of Engineering will leave their administrative posts on July 1, planning to devote future activities to teaching and research instead of administration; they are:

□ **Wilbur B. Davenport**, Sc.D.'50, Head of the Department of Electrical Engineering and Computer Science



B. Magasanik

The Monod Professorship to a Follower of Monod

Boris Magasanik, Professor of Microbiology who through more than three decades of carefully-conceived and delicately-executed cell research has helped illuminate the complex genetic and biochemical mechanisms that control the life and function of cells, is now M.I.T.'s first Jacques Monod Professor.

The Professorship, established with funds provided through the current \$225 million Leadership Campaign, is named for the distinguished French biochemist with whom Professor Magasanik worked as a Guggenheim Fellow in 1959 in Paris. Dr. Magasanik's work on cellular processes continues pioneering studies for which Dr. Monod shared the Nobel Prize in 1965.

Dr. Magasanik came to M.I.T. in 1960 from Harvard Medical School; a native of Russia, he studied at the University of Vienna, City College of New York, and Columbia University; he was Head of the Department of Biology for a decade beginning in 1967.

Motorola Joins VI-A

Motorola, Inc., has signed on as a participant in the Cooperative Course in Electrical Engineering. The first M.I.T. students will go to work in the company's Communications Division in Schaumburg, Ill., this summer. Negotiations to bring Motorola into the VI-A group began last year between **William J. Weisz**, '48, President of the Company, and **James D. Bruce**, Sc.D. '64, Associate Dean of the School of Engineering.

□ **Rene H. Miller**, Head of the Department of Aeronautics and Astronautics.

Professor Davenport, who's been Department Head since 1974, wants to devote the next years of his career to work in communications system technology and policy. Professor Miller, who's been Department Head since 1968, is completing a one-year term as President of the American Institute of Aeronautics and Astronautics.

"Beating the Statistics" With the First Sloan Fellows

In 1938, just 40 years ago, there were 164 applicants for five fellowships from the Alfred P. Sloan Foundation for a year's study in management at M.I.T.

And after their pioneering year with the late Professors Wyman P. Fiske, Erwin H. Schell, '12, and others, the first five Sloan Fellows went on to successful business careers — and to frequent reunions at which the spirit of their year at M.I.T. has been nurtured and renewed.

The picture was made at their most recent reunion — in October, 1977, at Chapel Hill,

N.C. Left to right: **E. Scott Pattison**, retired President of the Soap and Detergent Association; **Wayne J. Holman, Jr.**, retired Director and former member of the Executive Committee of Johnson and Johnson, Inc.; **Walter K. Graham**, formerly Vice President and Director of Industrial Relations of the New York News, Inc.; **M. Wren Gabel**, formerly General Manager and Executive Vice President of Eastman Kodak Co.; and **Elliott M. Gordon**, formerly President and Chairman of Towle Manufacturing Co.

"Think of it," said one of the five in Chapel Hill: "After 40 years all five still married to the same women and all in good health. . . . It sure beats the statistics!"



Basic Energy Science for Nonscientists: "Jocks" Have Only One Horsepower

Of 100 carloads of coal used to make electricity to light incandescent bulbs, the energy from only two carloads can be found in the light from the bulbs; the other 98 carloads are "wasted" in inefficiencies of the system.

A cuckoo clock uses energy at the rate of about 2 milliwatts — or only 1 milliwatt if the cuckoo mechanism itself is not operated.

These facts are among those learned by students in an interdisciplinary laboratory course, "Matter, Energy, and Life," given by **David R. Sokoloff**, Ph.D. '72, and several colleagues at the University of Michigan — Dearborn. The idea is to use simple concepts from daily life to give nonscience majors some basic ideas about science with which any educated citizen should be familiar — the foundations of a "scientific literacy," says Dr. Sokoloff reporting his work in *The Physics Teacher* (February, 1978).

In his energy experiments for the course, Dr. Sokoloff wanted to give a sense of energy consumption, conversion, and the "energy crisis." In "Ask watt energy can do

for you," his students run up a flight of stairs and learn that to do so each person produces about one horsepower — class "jocks" included; they calculate that the human body's energy use — 3,000 kcal. per day — is about the same as that of a 100-watt light bulb; and they discover the concepts of entropy and energy conservation.

In "Only a fuel would know," students use home-made calorimeters to compare the heat content of wood and three kinds of coal. "Are we running out of energy?" uses an energy simulator (analog computer) available from the Department of Energy to show the interaction of supply and demand for energy and fuels. And in "What's a watt?" students calculate the efficiency of some common energy-consuming devices — incandescent and fluorescent light bulbs, gas and electric hotplates, and a solar cell.

Dr. Sokoloff is convinced that his students learn a good deal about energy and have a good deal of fun doing it, and he thinks the experiments he and his colleagues have devised could easily be used at other schools just as effectively — even at those where budgets are very limited.

VIII

Physics

Robert D. Maurer, Ph.D. '51, is the recipient of the first American Institute of Physics Prize for the Industrial Applications of Physics. Dr. Maurer, Manager of Applied Physics Research at the Corning Glass Works, was cited for "contributions made to the practical application of optical communications through the understanding and discovery of materials and techniques for the fabrication of glass fiber waveguides."

Charles W. Tittle, Ph.D. '48, is currently engaged in full-time teaching and research at Southern Methodist University, working in variable-G cosmological modeling. . . . **Kenneth J. Rothschild**, Ph.D. '74, Assistant Professor of Physiology at Boston University Medical School and Assistant Professor of Physics at Boston University, is investigating the retina of the eye and how it responds to light, using laser light scattered from the photoreceptor membrane of the retina to study the structure of various components of the membrane.

X

Chemical Engineering

Christos Georgakis, who's been Assistant Professor of Chemical Engineering since 1975, is now Esther and Harold E. Edgerton Assistant Professor — an appointment that recognizes his special contributions through teaching and research. Dr. Georgakis' studies have been in the field of chemical process control and the design of chemical reactors.



D. H. Klipstein

David H. Klipstein, Sc.D. '56, has been appointed Director of Advanced Technology at Research-Cottrell, Inc. He will coordinate areas of technology affecting businesses and those which provide new business opportunities. Dr. Klipstein is a member of the American Institute of Chemical Engineers and the American Chemical Society. . . . The board of directors of The Badger Co., Inc. has elected **Robert E. Siegfried**, S.M. '47, to the position of Chairman and Chief Executive Officer. Mr. Siegfried has served as president of Badger

since 1968. . . . The Society of Automotive Engineers has elected **John M. Campbell**, '25, to the grade of Fellow, citing his contributions in the late 1920s to understanding the relationship between the molecular structure and "knocking" characteristics of fuels.

XV

Management

A new department for manufacturing information systems has been added to the data processing organization of Georgia-Pacific Corp. and **Roy N. Poust**, S.M. '66, was named manager of this department. Before his employment at Georgia-Pacific, Mr. Poust was manager of pulp and paper systems development for Crown Zellerbach in San Francisco. . . . **Thomas R. Williams**, S.M. '54, of Atlanta, Ga., has been re-elected to the board of directors of National Life Insurance Co. of Vermont. He is also chairman of the board of The First National Bank of Atlanta and the First National Holding Corp., Atlanta. . . . **Pat Callahan**, S.M. '75, is living in San Francisco and working at Crocker National Bank and states, not surprisingly, "Love California."

Colby Chandler, S.M. '63, President of Eastman Kodak Co., has been elected to the University of Rochester Board of Trustees. His other activities in community affairs include: a member of the board of directors of the Rochester Philharmonic Orchestra, the United Community Chest of Greater Rochester, the Industrial Management Council. He is also a member of the Rochester Association for the United Nations, the Chamber of Commerce, the American Society for Quality Control, and the Society of Photographic Scientists and Engineers.

Edward R. Vrablik, S.E. '70, has been elected to The Fertilizer Institute Board of Directors. He is President of Swift Agricultural Chemicals Corp., Chicago, Ill. . . . **Kenneth Dadzie**, S.E. '72, Ghana's Ambassador to Switzerland and Austria, has been selected by United Nations Secretary General Kurt Waldheim for the new second-ranking U.N. post of Director General for Economic Development. . . . **Larry P. Yermack**, S.M. '62, has been appointed Manager of the NOVA Satellite Program of the RCA Astro-Electronics' Space Communications Systems Department. Mr. Yermack will be responsible for the development and production of NOVA, a new U.S. Navy navigation satellite scheduled for launch in 1979. Prior to his present position, Mr. Yermack was Deputy Program Manager for the Defense Meteorological Satellite Program.

J. D. Nyhart, Associate Professor of Management and Ocean Engineering, has been named to the United States Public Advisory Committee on the Law of the Sea which is headed by Elliot Richardson. Professor Nyhart will serve on the Committee's Hard Minerals subcommittee which will consider the problem of ocean mining and study the possibility of an international authority the U.S. and other industrial nations will accept.



As he announced a 24,000-square-foot addition to his Spire Corp.'s plant in Bedford, Mass., **Roger G. Little**, S.M. '64, played host to Governor Michael Dukakis of Massachusetts (right). Spire Corp., which began as Simulation Physics, Inc., in 1969, is engaged in nuclear science and solar energy conversion, and Governor Dukakis said its expansion "symbolizes Massachusetts' special ability to spawn new and expanding high-technology firms." (Photo: Arthur Pollock from the Lowell Sun)



When he saw last winter's coal strike approaching, **Wayne L. Horvitz**, S.M. '53, Director of the Federal Mediation and Conciliation Service, took an unusual tack: he helped the President of the United Mine Workers recruit a staff capable of negotiating effectively with the professionals who were already at work for the mine owners. It was typical of Mr. Horvitz' wish (sometimes frustrated) to "head off labor-management conflicts before they reach a crisis state," says **Phillip Shabecoff** of the New York Times. (Photo: Neal Boenzi New York Times)

A "Fairly Good Cocktail Pianist" Joins Miners and Owners in the Coal Strike

Wayne L. Horvitz, S.M. '53, was an expert in labor relations even before he came to M.I.T. in 1952 with a Sloan Fellowship; now, 25 years later, he's had the biggest job of his career. As Director of the Federal Mediation and Conciliation Service (appointed last fall by President Jimmy Carter), Mr. Horvitz used his talents and faith in collective bargaining to work with owners and workers throughout the coal strike of last winter.

Though his prodigious effort seemed unrewarded for many weeks, without it the situation could have been far more chaotic.

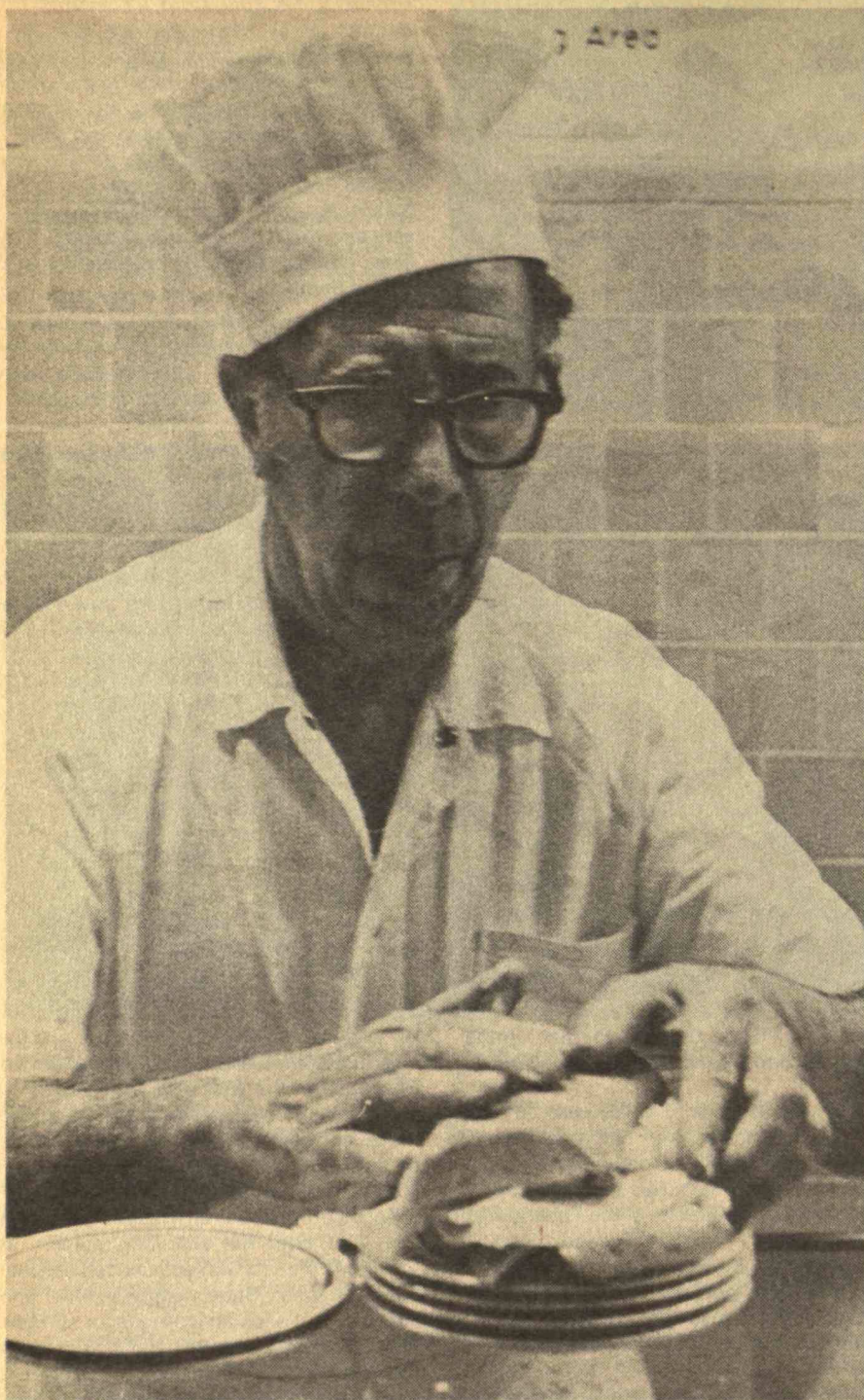
Mr. Horvitz began working with the United Mine Workers long before the strike deadline, using tactics unusual for the Service of which he had just been made head. Seeing that U.M.W. President Arnold R. Miller was almost alone in his headquarters office, Mr. Horvitz started recruiting for the U.M.W. the staff it would need to prepare and conduct the forthcoming negotiations; without balanced staffs for owners and miners, thought Mr. Horvitz, there could be no effective collective bargaining between the two sides.

The strategy was consistent with Mr.

Horvitz' faith in the process of frank and full negotiation. It works, he told **Phillip Shabecoff** of the *New York Times* early in the winter: "People hear a lot about the tough situations like the coal negotiations," he said. "But they don't realize that 90 per cent of our cases are settled peacefully."

As Vice President of Matson Navigation Co., just after his year-long studies at M.I.T., Mr. Horvitz worked out a relationship between West Coast longshoremen and shippers that ended crippling labor strife on the West Coast. Later he was Chairman of a joint labor-management committee of the supermarket industry; as a result he wins praise from **Joseph Danzansky**, Chairman of Giant Foods: "He is very straightforward and impresses you as never having anything up his sleeve. But he is also the kind of person who never takes 'no' for an answer," Mr. Danzansky told the *New York Times*.

Mr. Horvitz describes himself as "a frustrated jazz musician" who plays "a fairly good cocktail piano"; when he took his new job in President Carter's administration, Mr. Horvitz' sons, who share his interest in jazz, wrote an original composition in his honor: "The Federal Mediation Board Blues." Premonitions of the frustrations of the coal strike?



He bubbles over with conversation, smiles, and warm greetings to "regulars" as he does his job. It's a position he has held — and enjoyed tremendously — for 35 years. Joseph Di Napoli is the man who makes sandwiches at Walker Memorial cafeteria. He can whip one up in 20 seconds — creating between 250 and 300 a day, the cashier estimates. (In 35 years that is a lot of sandwiches.)

His responsibilities include breakfast, so his day starts at 4:00 a.m. and he arrives at work at 5:30 to begin the job of cooking bacon (perhaps 20 pounds), sausage (10 pounds), and scrambled eggs. Then he must get ready for the lunch rush. He takes

pride in always using fresh ingredients —and that he gives people the best. Have M.I.T. students changed in the years Mr. Di Napoli has viewed them across the counter? "Their appearance, yes — they are not as neatly dressed now; they have longer hair. There was a time they couldn't come in unless wearing a tie," he says. But the character of the students hasn't changed — "they have always been good workers," he adds.

He feels it's part of his job to talk to the customers, and that is a part he especially enjoys. He likes to be with people, he emphasizes — they're part of his life.

(Photo: John M. Grunsfeld, '80)

People

Dean for Engineering Education

Professor **Joseph M. Sussman**, Ph.D. '68, who heads the Transportation Systems Division in the Department of Civil Engineering, is now Associate Dean for Educational Programs in the School of Engineering. He's working especially on new teaching programs under development and near implementation throughout the School.

Professor Sussman succeeds Ernest G. Cravalho, who — as Matsushita Professor of Mechanical Engineering in Medicine — is taking on new work at the Harvard-M.I.T. Division of Health Sciences and Technology; he's known for work on applying cryogenics to biology and medicine.



R. Hagopian

Corporate Relations for the Campaign

Robert Hagopian, '47, has assumed increased responsibilities in the area of resource development and is now Director of Corporate Relations, in charge of programs of the National Business Committee in M.I.T.'s ongoing \$225-million Leadership Campaign.

Mr. Hagopian will continue to maintain close ties with the Industrial Liaison and Associates Programs, for which he was previously Institute Secretary.

The National Business Committee is chaired by Richard L. Terrell, S.M. '58, Vice Chairman of the Board of General Motors Corp. Its internal operations are being coordinated by Mr. Hagopian in association with Professor Irwin W. Sizer, former Dean of the School of Science who is now consultant for resource development, and by Professor J. Francis Reintjes, who retired last year from the Department of Electrical Engineering and Computer Science.

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Bringing African Art to Burton House

When **Julian** and **Doreen Beinart** moved into Burton-Conner House as faculty residents this summer, they brought with them a unique and important collection of African art, two children, and a determination to create a family experience for 350 undergraduate men and women.

Professor Beinart came to M.I.T. as Professor of Architecture in 1970, having been for two years Dean of the Faculty of Fine Art and Architecture at the University of Cape Town; he's a native from South Africa with degrees from the University of Cape Town (B.Arch. 1954), M.I.T. (M.Arch. 1956), and Yale (M.C.P. 1958). Mrs. Beinart, meanwhile, is working as a consultant to a series of day-care programs in the Boston area, helping them improve services and upgrade curricula.

Professor Beinart has taught at two universities in South Africa, was at M.I.T. in 1969 and 1970, and earlier conducted a series of short courses in design in five African countries.



The presence of Professor and Mrs. Julian Beinart as faculty residents in Burton-Conner House assures for 350 M.I.T. undergraduates a unique exposure to African art and culture. (Photo: Calvin Campbell)

Individuals Noteworthy

M.I.T. Changes

Walter Alessi, **John Benedick**, and **Manuel Weiss**, '71, have been promoted from Instructors to Assistant Professors in the Athletic Department; all are full-time coaches — Professor Alessi of lacrosse and soccer, Professor Benedick of men's and women's swimming and water polo, and Professor Weiss of women's tennis and freshman squash.

John E. Newcomb, Jr., Assistant Director for Administration of the Center for Advanced Engineering Study, is Associate Director of the Center.

Donna R. Savicki, Assistant to the Director of the Innovation Center, to Administrative Officer of the Department of Aeronautics and Astronautics . . . **Robert L. Kehner**, library staff member, to Assistant Librarian for Documents in the Dewey Library . . .

Virginia Gunter, a Fellow in the Center for Advanced Visual Studies who was formerly Director of Exhibitions and Programs and Assistant Professor in Fine Arts at the Massachusetts College of Art, to Gallery Manager for the Margaret Hutchinson Compton Gallery in the Alumni Center (Building 10).

Sharon Basco, formerly columnist for the *Boston Herald American* and investigative reporter for Jack Anderson, to Publicity Manager for the M.I.T. Press . . . **Cynthia C. Bloomquist**, '70, Assistant Director of the M.I.T. Associates Program since February, 1977, to Director . . . **Isaac M. Colbert** to Senior Consultant/Trainer in the Office of Personnel Development; he was formerly Assistant Professor of Psychology at Northeastern University.

Jean Heiney, formerly women's tennis coach at Valparaiso University, to women's basketball coach . . . **Thomas R. Henneberry**, who came to M.I.T. in 1974 as Assistant Director of the Associates Program, is now Assistant Director of the Office of Planned Giving and Legal Affairs, Resources Development . . . **Eric C. Johnson**, '67, Senior Industrial Liaison Officer, to Assistant Director of the Industrial Liaison Program.

J. H. Clausen, Ph.D.

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Christopher Lane, Acting Assistant Headmaster of English High School, Boston, to coach of cross country and assistant coach of track and field, part time . . . **John Mack**, formerly Assistant Director, to Associate Director of Admissions with special responsibility for enrolling minority students . . . **Harriett Pearce**, a graduate of Indiana University, to trainer for women's athletics . . . **Arturo A. Rosales**, '69, Senior Industrial Liaison Officer, to Assistant Director of the Industrial Liaison Program . . . **H. Dany Siler**, '68, to Assistant to the Director of Admissions with primary responsibility for statistical analysis.

National Magnet Laboratory Promotions

Three new Associate Directors of the Bitter National Magnet Laboratory: **Roshan L. Aggarwal**, a member of the Laboratory's Quantum Optics and Plasma Physics Group, to be responsible for administration of National Science Foundation programs . . . **D. Bruce Montgomery**, '57, Leader of the Magnet Research and Technology Group, to lead the development of high-field magnets for the National Science Foundation, Department of Energy, and Plasma Fusion Center . . . **Ronald D. Parker**, Sc.D. '67, who is also Professor of Electrical Engineering, to correlate Magnet Laboratory efforts for the Plasma Fusion Center.

Simon Foner, a founding member of the Bitter National Magnet Laboratory who heads its Magnetism and Superconductivity Group, is now Chief Scientist.

Fellows

John M. Dixon, '55, Editor of *Progressive Architecture*, to the College of Fellows of the American Institute of Architects.

Rising and Changing in the World of Business

Michael S. Adler, '65, to Manager of the Archival Memory Program (development of a large-volume computer memory for long-term storage of information) at the General Electric Research and Development Center, Schenectady . . . **Holt Ashley**, Sc.D. '51, Professor of Aeronautics and Astronautics and of Mechanical Engineering at Stanford University, elected to the Board of Directors of Hexcel Corp., San Francisco . . . **E. Patrick Coady, Jr.**, '60, to Senior Vice President of Dillon, Read and Co., Inc. . . . **Paul F. Levy**, '72, Deputy Director of the Massachusetts Energy Policy Office (see *Technology Review* for February, pp. 36-43) named by Governor Michael S. Dukakis to be Commissioner of the Department of Public Utilities.

John W. Matton, '65, to District Manager for Detroit in the Sales Department of C-E Power Systems (Combustion Engineering, Inc.) . . . **Roy N. Proust**, S.M. '66, formerly manager of Pulp and Paper Systems Development for Crown Zellerbach, San Francisco, to Manager of Manufacturing Information Systems, Georgia-Pacific, Portland,



T. L. Whitehouse



C. A. Zraket

Ore. . . . **George A. Wallace, Jr.**, '53, to Corporate Vice President — Administration of Olin Corp., Stamford, Conn. . . . **Barry D. Wessler**, '65, to Vice President of Telenet Communications Corp., Washington, D.C.

Thomas L. Whitehouse, '57, formerly Plant Manager, to Vice President — Manufacturing of Stanley Air Tools Division, the Stanley Works, Cleveland . . . **Thomas R. Williams**, S.M. '54, Chairman of the Board of the First National Bank of Atlanta and the First National Holding Corp., Atlanta, Ga., re-elected to the Board of Directors of the National Life Insurance Co. of Vermont . . . **Charles A. Zraket**, S.M. '53, formerly Senior Vice President — Technical Operations, to Executive Vice President and Director of the Mitre Corp., Bedford, Mass.

William E. Harper, '47, Group Vice President of the Greater Providence Chamber of Commerce, has been named Administrative Assistant to the President of Moran Transportation Industries, Inc., Warwick, R.I. . . . **Donald F. Holloway**, '38, to Director of Research and Development, Fred Rueping Leather Company, Boston . . . **Herbert Kay**, '47, Senior Vice President AMAX, Inc., Molybdenum Division, to Corporate Vice President, AMAX, Inc. . . . **Charles H. Hoffman**, '39, Vice President, energy pooling, Public Service Electric and Gas Company, Newark, N.J., to Senior Vice President, system planning and interconnections, PSE&G . . . **Robert M. White**, S.M. '49, administrator of the National Oceanic and Atmospheric Administration, to Chairman, Climate Research Board, the National Research Council . . . **Richard A. Holthaus**, '69, to Vice President, Citicorp., New York City.

Perry Dean Partners, Inc., of which **Robert C. Dean**, '26, is principal, and Stahl Associates, the firm of **Frederick A. Stahl**, M.Arch. '55, have joined to form the architectural practice of Perry, Dean, Stahl, and Rogers, Inc.; Mr. Dean is Chairman and Mr. Stahl President of the new firm, Perry Dean Partners, founded in 1923 as Perry, Shaw, and Hepburn, is known internationally for the restoration of Colonial Williamsburg; the firm has completed a number of buildings at M.I.T. including the Sloan Metals Processing and Hydro-

dynamics Laboratories. Stahl Associates is known for the 34-story State Street Bank building in Boston and for the renovation of the Old Federal Courts Building in St. Paul, Minn.

Herbert E. Calves, Jr., '58, appointed General Manager of the Charlotte service center, Joseph T. Reyerson and Son, Inc. . . .

Roland V. Danielson, '42, to Manager, Ship Development and Sales, Bethlehem Steel Corporation's Shipbuilding Department . . . **Etto E. Von Zastrow**, '50, named Manager, Solid State Power Control Branch, at the General Electric Research and Development Center, Schenectady, N.Y. . . . **Paul Kudirka**, '69, appointed Assistant Patent Counsel, at Digital Equipment Corp., Maynard, Mass.

John F. Becker, '53, promoted to Project Manager, Light Flat Rolled Products, Management Information Systems, in the steel operations department of Bethlehem Steel Corp., Chesterton, Ind. . . . At Coming Glass Works, Coming, N.Y.: **George W. McKinney III**, '65, appointed Business Development Manager, Consumer Products; **Gillett Welles III**, S.M. '63, appointed Director of Manufacturing and Engineering, Europe; **W. Thomas Brydges III**, appointed Director of Planning, Technical Staffs Division.

Honors and Awards

Four of eight medalists chosen by the Franklin Institute for 1977 were M.I.T. alumni: to **Norris F. Dow**, '39, Chairman of N. F. Doweave, Inc., the Edward Longstreth Medal for the extra-strong triaxial method of weaving and for a loom to utilize it . . . to **Cyril M. Harris**, Ph.D. '45, Professor of Electrical Engineering and Architecture at Columbia University, the Franklin Medal for contributions to acoustics, acoustical engineering, and architecture . . . to **William A. Krivsky**, '51, Senior Vice President of CertainTeed Corp., the Francis J. Clamer Medal for invention of the argon-oxygen-decarburization process for making stainless steel . . . and to **Stewart E. Miller**, '41, Director of Bell Telephone Laboratories' Guided-Wave Research Laboratory, the Stuart Ballantine Medal for contributions toward light-wave communications systems.

Samuel C. C. Ting, Thomas Dudley Cabot Professor of Physics, honored as a "master achiever" by the American Academy of Achievement . . . **Robert M. Suskind**, Associate Director of the Clinical Research Center, acted as Chairman of the symposium on pediatric nutrition held recently in Boston.

Walter C. Eberhard, 1893-1978

Walter C. Eberhard, '14, Assistant Professor, Emeritus, of Mechanical Engineering, died on February 16; he was 85.

Professor Eberhard joined the M.I.T. faculty in mechanical engineering in 1919, five years after finishing his degree in that field. He retired in 1957 and continued as Lecturer until early in the 1960s.

Silvio N. Vitale, 1911-1978: His Teams Ruled New England Fencing

Silvio N. ("Maestro") Vitale, M.I.T.'s fencing coach for 27 years before his retirement in 1975, died February 7 at his retirement home in Melbourne, Fla., after a brief illness. He was 67.

During more than a quarter-century of Mr. Vitale's coaching at M.I.T., teams under his tutelage won 13 titles in New England — including seven in a row between 1968 and 1975 — and in 1974 and 1975 captured the "Iron Man" trophy of the Eastern Foil Championship. During the 27 years there were 147 individual victories by M.I.T. fencers.

Even while studying at the Royal Academy of Fine Arts in Rome, following graduation from Dorchester High School, Mr. Vitale was distinguishing himself as a fencer: he was All-Weapons Champion in the Italian University Regional Competitions of 1932, 1933, and 1934. Then he went on to teach fencing at Bowdoin, Curry, and Emerson Colleges while conveying his love of the sport to thousands of M.I.T. students.

Mr. Vitale was a long-time member of the National Fencing Coaches Association and held its title of Fencing Master.

Robert L. Loria, 1928-1978

Robert L. Loria, Operations Manager at the Laboratory for Nuclear Science, died after a short illness on February 2; he was 50.

As Operations Manager, Mr. Loria had major responsibility for procurement of the special equipment and apparatus used in the Laboratory's research in nuclear and particle physics; he was regarded as an expert in that specialized procurement field. He joined the Laboratory's administrative group in 1956. Mr. Loria studied business administration at Boston University, held the J.D. degree from the New England School of Law, and was a member of the Massachusetts Bar Association.

Deceased

Frank K. Mitchell, '02; August 1, 1977; 21A Pine St., Harwich Port, Mass.

Clarence M. Joyce, '03; February 9, 1978; 619 Chia Rd., Palm Springs, Calif.

Fred M. Pierce, '04; December 10, 1977; 121 Acushnet Ave., Worcester, Mass.

G. Gifford Symes, '07; April 12, 1967; Symes Bldg., Denver, Colo.

Willis G. Waldo, '07; October 28, 1976; 319 Kings Ct., West Palm Beach, Fla.

Albert L. Gardner, '11; February 6, 1978; 31 Wilbur St., South Weymouth, Mass.

Arthur W. Kenney, '13; January 25, 1978; Pine Rest, Franklin St., Northampton, Mass.

James F. Morgan, '14; November 28, 1977; 1434 Punahow St., Honolulu, Hawaii

Clarence W. Harvey, '16; March 12, 1975; 1055 Westchester Dr., Sunnyvale, Calif.

Earle C. Pitman, '16; February 18, 1978; Norumbega High St., Camden, Maine

Mrs. William L. Dennen, '17; February 27, 1978; R. D. #1, Dalton, Penn.

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Mrs. Marion C. Kenney, '18; December 30, 1977; Pine Rest, Franklin St., Northampton, Mass.
 Carl P. McLaughlin, '18; July, 1977; 3309 Culver St., Evanston, Ill.
 Howard H. McClintic, '19; January 30, 1978; 3524 Oleander Way, Delray Beach, Fla.
 Mrs. Alice Bronfenbrenner, '21; September 17, 1977; 245 Union Blvd., St. Louis, Mo.
 Albert H. Wechsler, '21; February 28, 1978; 790 Boylston St., Apt. 20H, Boston, Mass.

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Milton O. Carlson, '22; February 3, 1977; Amesbury Ln., Little Compton, R.I.
 Geoffrey B. Gilbert, '22; December 21, 1977; Apt. #307, 1270 Beach Dr., Victoria, B. C., Canada
 H. Douglas MacDonald, '22; January 27, 1978; 39 Harrison Ave., Apt. 25, Montclair, N.J.
 James E. Murley, Jr., '22; February 15, 1978; Murley Ln., Newton Center, Mass.
 John B. Wright, '22; June 16, 1977; 870 Boston Post Rd., Madison, Conn.
 Frederick J. Ranlett, '23; January 29, 1976; c/o Richard J. Kenny, 520 Paseo De Los Reyes, Redondo Beach, Calif.
 William H. Correale, '24; February 22, 1978; 34-40 79th St., Jackson Heights, N.Y.
 John F. Burke, '27; January 20, 1978; 84 Lincoln Ave., Wollaston, Mass.
 Benedict E. Hirshon, '27; March 7, 1978; 36 Kenwood St., Brookline, Mass.
 Charles G. Kloer, '27; September 13, 1977; 111 E. Golden Lake Ln., Circle Pines, Minn.
 Harold W. Northcutt, '28; December 13, 1977; 1249 Leisure Ln., #5, Walnut Creek, Calif.
 Winfield H. Bearce, '29; March 5, 1978; 175 Second St., S., Naples, Fla.
 George J. Burke, '29; January 25, 1978; 285 Forest Ave., Swampscott, Mass.
 Robert A. Sidur, '30; December 31, 1977; Nan Realty Co., Inc., P.O. Box 568, Chatham, N.J.
 James E. Paige, '32; January 5, 1969; c/o Philip J. Durkin, 256 Essex St., Salem, Mass.

Frank J. Brazel, '34; January 13, 1978; Althea Ln., Darien, Conn.
 Albion R. Fletcher, '35; February 22, 1978; 135 West St., Braintree, Mass.
 Clyde F. Cameron, '36; July 12, 1977; 3040 Devon Rd., Victoria, B.C. Canada
 Harold A. Carmichael, '36; February 14, 1978; 4 Robinwood Ln., Rutland, Vt.
 Robert York, '38; January 7, 1978; 214 Fall View Terr., Ithaca, N.Y.
 Louise Odiorne, '39; November 19, 1977; Tech-Stone, Inc., Box 7, Yellow Springs, Ohio
 Geza E. Neuman de Vegvar, '42; February 22, 1978; 20 Cotswold Way, Scarsdale, N.Y.
 Arthur S. Karol, '44; February 23, 1978; 332 Charles Court East, Needham, Mass.
 Joseph R. Altieri, '49; January 27, 1978; Craigue Hill Rd., R.F.D. #1, Springfield, Vt.
 Thomas Hudson, Jr., '49; January 15, 1978; 14 Oak Knoll Dr., Wallingford, Penn.
 Walter Dedrick, '53; September 28, 1977; 175 Bayshore Ave., Long Beach, Calif.
 James B. Williams, '56; February 24, 1978; 10 Statham Rd., Lexington, Mass.
 Bruce E. Mather, '64; November, 1975; 163 Conant Rd., Westwood, Mass.
 John H. Peters, '71; December, 1976; Peters Assocs., Inc., Box 297; 2 Ox Point Dr., Kittery, Maine
 Charles F. Wendler, '72; July 2, 1977; 4520 Bishop Rd., Detroit, Mich.
 Patricia Raynor, '73; May 20, 1976; 41 Dorr St., Roxbury, Mass.

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Technology transfer embraces a variety of values and goals — both corporate and national. And when these conflict, the channels of transfer are not easy to negotiate.



Human feet continue to be the best means of transporting goods from place to place in Nepal. Motorcycles will be of limited

usefulness until such time — if ever — roads are built to connect the minor cities. (Photo: Ira Kirschenbaum for Stock, Boston)

that formerly made direct foreign investments only as sole owners are now willing to be minority stockholders in joint ventures. Government restrictions in developing countries dilute the freedom the companies enjoyed in the past. Developing-country partners usually insist on greater dissemination of technology from the head office to the subsidiary. And contract clauses may require the head office to train officials of the joint venture itself, and others whom the host government wishes to instruct in certain technologies. Even so, TNCs often have more to

gain by entering into joint ventures than by rejecting them: they may find they can do no better in a given market, or they may wish to assure themselves a privileged position in selling raw or semi-processed materials or equipment, to gain information about local markets or supply sources, or to prevent a competitor from gaining the same advantages.

To the extent that Third World governments and firms clearly understand these goals of TNCs, they can negotiate more satisfactory technology transfers with them.

□ *Overseas licensing* constitutes a relatively minor source of income according to TNC executives. But licensing remains advantageous for various motives:

- to profit from technologies whose competitive edge in home markets is fading;
- to gain access to markets where direct investment is excluded by government policy, general practice, or specific discrimination;
- to seize opportunities for improving technologies in circumstances resembling those found in Third World markets;
- to gain the goodwill of governments by supplying them with technology even when no great economic advantage accrues;
- to win favorable publicity by actions which keep the company's name in the public eye.

Licensees in turn enter contracts for their own motives. Usually, they lack the technology in question and cannot produce it themselves — or cannot produce it quickly or inexpensively. They view licensing as the normal recourse. Some licensees are driven to procure up-to-date technologies used by leading firms in “developed” countries. Considerations of scale also weigh heavily on licensees; their market is often too small to justify investing in research and development to generate the technologies they need.

Terms of licensing agreements vary greatly within different companies, industries, and countries. Many variations are traceable to the nature of technologies as product- or process-centered. Typical product-embodied licenses contain such clauses as these:

- Exclusive rights are granted licensees to sell the product within stipulated territories.
- Advertising of the licensed product is strictly controlled.
- Licensees must supply random samples of their products to the licensor, who controls quality; licensees must report on sales promotion efforts, the qualifications of personnel assigned to licensed production, the licensee's evaluation of a competitor's products, and so forth.
- Licensors claim rights to inspect the licensee's factory.
- Licensors pay licensees for material samples sent for quality inspections.
- Licensors require partners to register products in all countries whose legislation requires it.
- Licensees are usually obliged to place a licensed product on the market within a specific time period, although extensions can be negotiated.
- Royalty percentages and modes of payment are specified in detail.
- Technological know-how must be treated by licensees as confidential under pain of contract cancellation.

□ The duration of licensing contracts varies widely: often it is three, five, or seven years, occasionally renewable.

With TNCs, control takes priority over profit. This is the general pattern of international technology sales. TNCs and their affiliates see technology transfers as strategies for successful marketing. So they think the restrictions imposed by Third World governments are unreasonable. Governments of developing countries, however, see the acquisition of technology as an end in itself; their own priorities are to build a pool of technologically skilled citizens, to circulate imported technologies throughout nationally owned industry, and to prevent money from flowing out of the country. Moreover, host governments rarely approve contractual restrictions on sales to other Third World countries.

Conflicts in licensing contracts are frequently the product of this discrepancy. Despite frequent mutual dissatisfaction, many licensing contracts are signed because firms in developing countries desire technology and TNCs seek access to global markets. So even where priorities diverge, mutual advantage remains possible. Thus attaining minimum satisfaction for both partners in their primary objective becomes the threshold below which contracts will be denounced as exploitive.

The conflict between developing countries and non-profit agencies based in rich countries is similar. Rich country universities, foundations, and private aid agencies want to build their own institutional capacity to teach and conduct research on specific problems; they tend to treat developing countries as a testing-ground for their preferred methodologies. Moreover, universities will frequently contract with international agencies such as the World Bank to “transfer” technology to some host agency in a developing country. The country, however, would rather train its local experts, solve specific problems, or master the methodology itself.

Licensing, as a means to transfer technology, is bound closely to training agreements. Many licensees value training clauses more highly than those bearing exclusively on transfers. Particularly in process technologies, the right to send local personnel to home factories and laboratories takes priority. Besides enhancing a firm's capacity for fruitful assimilation of technology, training is a step toward eventually acquiring the ability to produce one's own technology. The ability of developing-country firms to benefit from technology purchases is usually conditioned by the existence within them of those whom Thomas Allen calls the “technological gatekeepers” (*see October/November, 1977, pp. 26-33*). “Gatekeepers” are engineers, technicians, and other workers within a firm who maintain access to an external network of foreign in-

Ninety-eight per cent of the money spent for research and development in non-socialist countries is spent in rich countries. Policymakers in poor countries view this monopoly with alarm . . .

formation sources, and to an internal network that funnels useful information for practical application. Unless both networks are diversified and used frequently, they atrophy.

□ *The industrial fairs* in which TNCs participate are a good way to transfer technology indirectly. The Chinese have mastered this strategy by negotiating fairs of long duration and organizing visits by engineers and students who must assimilate the technology on display. At the fair's end, the Chinese purchase equipment at reduced prices, but they avoid signing technological training or maintenance contracts. These industrial fairs assume a dominant educational rather than a primarily commercial character. Nevertheless, since 1972 China has imported more advanced industrial technology and increased the number of foreign technicians allowed inside its factories. China's approach proves that a variety of opportunities exist to accomplish technology transfer, given the political will and organizational ability to do so. At the plant stage no less than at the national planning stage, technology is transferred most successfully when the final user expresses an explicit need, or plays some role in defining the problem to be solved. When final consumers of technology help formulate initial problems, the gap between research and development conceptualizations and actual application is reduced greatly.

This lesson is not lost on Third World recipients of industrial technology transfers. They seek to maximize their ability to absorb transferred technology. This requires, in the long term, endowing developing nations with independent research capacities, an aspiration thwarted by the monopoly of industrial research and development held by developed countries.

The Research and Development Monopoly

Ninety-eight per cent of the money spent for research and development in non-socialist countries is spent in rich countries. Policymakers in poor countries view this monopoly with alarm, but TNCs defend their near-monopoly by arguing that only advanced countries have large sums of ready capital; a pool of skilled researchers; proximity to manufacturing and marketing units which makes innovations responsive to practical constraints; and a supportive attitude toward research and development in society.

Scale is critical: many research managers argue that research and development investment in developing countries is impossible because production scales do not allow amortization of high and risky research costs. Only special circumstances make it profitable to build research and development units in Third World countries.



An exhibit of electronic entertainment doubles as a place for a shady nap in Jogjakarta, Java, Indonesia. (Photo: Jean-Claude Lejeune for Stock, Boston)

Under the sting of newly honed criticism, transnational corporations are discovering that they can no longer operate as before.

A case in point: Officers at Alcan Aluminum declared in late 1974 that the company was considering establishing a large research unit in Brazil. The project was thought attractive because:

- Brazil is sufficiently developed to support all phases of an aluminum/bauxite mining operation.
- Brazilian plants sell to foreign as well as domestic markets. (Although larger than most Third World markets, the Brazilian market would not suffice to warrant the projected investment were it not for these anticipated export markets.)
- Legislative restrictions imposed by the government made it imperative that Alcan find alternative ways to obtain the necessary technology for its Brazilian plants. These restrictions place ceilings on payments for technology imported from outside the country, and limit sources of such technology to those not covered by national suppliers.

Few countries can satisfy all these conditions, Alcan officials hastened to add. Thus in most cases TNCs do not want to install research and development facilities in Third World countries. Where exceptions exist, research activity by TNCs in the Third World is of short duration or is tied to fixed-term contracts with existing local research facilities. The motives which can persuade corporate managers to make research investments in developing countries are:

- to facilitate technology transfer from domestic laboratories to foreign subsidiaries;
- to monitor local demand or supply sources for opportunities which escape notice in home countries; and
- to improve the chances for successful innovation by permitting the development of foreign innovation opportunities close to their market source.

By and large, developing countries eagerly seek to retain their skilled scientists, engineers, and technicians even when they cannot all be employed by national firms. Nonetheless, few efforts have been made by U.S. TNCs to invest in overseas research and development other than in Canada or western Europe.

Bold action by individual firms might reverse this trend. For example, some years ago Bagó Pharmaceuticals, a medium-sized Argentine company, made a policy decision to achieve research and development autonomy. Bagó wished to reduce its high multiple licensing costs, and to reduce its dependence on outside suppliers, thereby proving that Argentine firms could perform as well as foreign competitors. The company also wanted to win the loyalty of researchers so they would stay with the firm for many years, a rare commitment among expatriate researchers. Within six years, Bagó's researchers had made technological breakthroughs which their former

licensors now purchase as licensees. A few firms in other developing countries have had similar success.

Another way to break the research and development monopoly of TNCs is to use assertive government action and, if necessary, direct subsidies. Many developing countries are verbally committed to build their own research infrastructure, particularly in branches of industry vital to national economies. Chile wants relative autonomy in copper; Bolivia in tin; Argentina in meat and wool. Without a clear policy vigorously pursued and subsidized, however, success is impossible.

The decision reached by the Argentine government in 1973 in the realm of nuclear energy for peaceful purposes is one example. Rejecting the adverse consensus of world experts, the government chose to pursue self-sufficiency in generating nuclear power using natural uranium, and not enriched uranium (obtainable, at that time, only from the U.S. or the Soviet Union). One major obstacle stood in the way: no permanent research capacity existed. It was created. So important gains are possible, but are achieved only by concerted effort.

Possession of research and development capacity improves the developing country's ability to assimilate imported technologies, and it provides institutional and personal incentives for research professionals to remain in their home countries. Thus governments can invest to improve the quality of medical research and service facilities in poor, remote areas, and at the same time provide financial and other incentives to doctors, nurses, aides, and paraprofessionals who might otherwise remain in congested capital cities. But it is wasteful to endow a country with a research and development infrastructure unless that research effort is effectively coordinated with industry's demands for technology.

Further, it does little good to increase the supply of national technology unless that technology can be directed to domestic markets that are otherwise satisfied by imports. Because international suppliers can shape demand in developing countries in their own best interests, something beyond mere "transfers of technology" to local research institutes is needed. This often degenerates to uncoordinated educational programs to upgrade local scientific personnel. Whatever their intrinsic merits, programs like these bear little relation to production. A better strategy is to locate research within industry or in close symbiosis with it. Any other solution wastes funds and courts failure.

Governments in developing countries might be wise to require selected TNCs to invest in local research projects as a pre-condition for operating within the country. Governments could also offer fiscal incentives to firms willing to build and supervise local research and development

facilities. Since most TNCs derive their competitive advantage from many sources — of which technological advance is only one — they might not see such clauses as unacceptable, especially for relatively stable industries. One common fear is that technologies adapted to Third World conditions cannot compete with those designed for the rich world. But prosperity is relative: rich countries themselves, subject to inflation and growing scarcities of food and fuel, may be obliged to adopt the more conservative production goals demanded in less developed lands. Developed countries, too, may be forced to maximize employment, to conserve scarce capital, to use technologies which do not deplete natural resources or spoil the environment, and which can work on smaller scales.

Many years must surely elapse before even the more prosperous Third World countries can build research and development infrastructures of a size, diversity, and strength comparable to those of rich nations. Thus for TNCs, establishing such facilities in the Third World could be a profitable enterprise for a long time to come. And given their long research tradition, TNCs need not feel threatened by the coexistence — alongside their own home-country facilities — of local Third World research and development units. These will still have to compete for skilled personnel, sophisticated laboratory equipment, and access to knowledge.

Mere physical presence of research laboratories in less developed countries will not guarantee that the technology developed and adopted will match local needs, any more than the implementation of manufacturing plants assures, of itself, that production will be geared to national priorities. The answer lies in national policies aimed at shifting the direction, composition, and quality of research toward social purposes broader than those routinely pursued by corporate research and development units. Unless such energetic action is taken, the “indigenization” of research and development will have as little success in reducing dependence as did import substitution in the industrialization phase.

Midwives of Technology Transfer

Many findings generated by research and development laboratories in rich countries reach the Third World only through the mediation of consulting firms. The term “consultant” as applied to firms embraces a variety of roles. Some consultants provide design and problem-solving services in specialized domains: hydraulics, food technology, or refrigerated transportation. Others tackle virtually any task: evaluating the managerial efficiency of a company or national government; making feasibility, site, or design studies of a paper mill; or advising

churches how to invest their portfolio in an ethical manner. Consultants claim capabilities to devise equitable tax systems, to plan bureaucratic reforms, to install data processing systems, to formulate national development plans, to map out regional tourist policies, and to train managerial decisionmakers. Consulting firms are often expert interpreters of information of potential usefulness to investors, governments, or labor unions. Large international consultants function like a consulate general. They post overseas their equivalents of labor attachés, economic advisers, political analysts, legal experts, statisticians, and public information reporters.

Why are consultants necessary? Answers given by consultant firms themselves are revealing. Arthur D. Little, Inc., declares its principal business to be: “The management of change and the optimal blending of change with continuity. . . . What this means. . . . is an approach to problem solving which combines:

- “General expertise in all the change areas that affect the . . . field — government regulations, technology, economics, society;
- “Specific expertise in marketing, organizational development, strategic planning, forecasting, modeling, finance; and
- “Most specifically, skills in operations, research, and planning for specific situations within the broad context of a burgeoning industry.”

Business International, in turn, declares itself capable of:

- “Providing fast, reliable information needed for corporate planning and decisionmaking;
- “Alerting corporate management at home and abroad to new opportunities and dangers;
- “Discovering, explaining and interpreting new international management techniques that will advance profitable corporate and economic growth;
- “Analyzing governmental measures that will make for sound economic growth and greater international cooperation and that will pave the way for corporations to make their maximum contribution to human welfare and to advance their own survival and prosperity.”

Just as consultants have eased the entry of inexperienced U.S. or European firms into competitive international arenas, they have also “lubricated” investment in countries formerly closed to western capitalist firms. Thus, the legal firm headed by Samuel Pizar in Paris has been broker for dozens of investment contracts between U.S. firms and the Soviet Union. American corporations are now studying entry into the People’s Republic of China on the strength of early soundings taken by consultant firms.

International consulting firms are likewise retained by companies, government agencies, and international or-

The Ford Motor Co. erected this sign to celebrate the completion of its Valparaiso, Chile, plant in December of 1969. The plant has since been nationalized. (Photo: Nicholas Sapienza for Stock, Boston)



ganizations to perform studies in developing countries. In the main, they utilize "decisional" technologies: expertise in diagnosing problems; abstract tools to simulate alternative policy courses and to weigh their benefits and costs; and systems that can organize all relevant data on markets, employment pools, available technologies, sources of capital, and legislation. Developing countries may retain consultants to learn what technologies are available from the rich world. Consultants are "technological gatekeepers," actively promoting the uses of new technologies by actual and potential clients who would not otherwise have known they existed or were needed.

International consulting is highly competitive. Intense competition sometimes leads top professionals to adopt, unintentionally, what they characterize privately as cynical or undesirable attitudes. The system of "billability" under which they must work is to blame, they say. A certain percentage of a professional's work time (usually

running to about 70 to 80 per cent of the total) is "billable" to a specific client. Consultants without a high "billability rating" don't qualify for promotion. Since competitive pressures force individuals to sell their billable time, they rarely question the values implicit in their own development models or those of clients.

Several Latin American government officials were interviewed on this matter. They deny that their agencies or private firms hire U.S. consultants to obtain diagnostic expertise, often available locally. But U.S. consultants do enjoy easy access to consortium bank financing, and know how to prepare funding proposals to such institutions as the World Bank or the United Nations. Consultants also enjoy the confidence of reputable corporations in the rich world. Third World economic actors prize the endorsement of a prestigious consultant firm as the seal of approval to entice potential investment partners, financiers, or suppliers of technology.

Among suppliers of technology, consultants are the

least vulnerable to restrictions or expropriation: their technology is embodied not in products or processes that come under the aegis of licenses, but in the intangible, accumulated "wisdom" that derives from contacts with a variety of clients, governmental and international bureaucracies, universities, research institutes, foundations, labor unions, citizens' groups, and voluntary agencies. Gatekeepers within international consultant firms can link the welter of economic, technological, and political issues that bear on managerial decisions.

Good consultants expect to survive longer in international arenas than mere suppliers of capital, product or process technologies, or managerial skills. Their expertise is diagnostic; they can coordinate the market and its financial underpinnings with the technology to be developed and produced.

The technologies in which consulting firms specialize are not readily transferred: training engineers to build dams is easier than transforming them into feasibility experts capable of evaluating myriad constraints on dam sites, design, and cost variables. Too few Third World countries have understood that these intangible skills are the basis for the most abiding form of technological dependence. By and large, consultants set the broad frameworks within which most technologies are transferred. In part because fees paid to consultants often come from international funding agencies, developing countries have not closely analyzed how dependent they are on foreign consultants. Yet consultants are the cement that holds the technology transfer nexus together: they serve simultaneously as mechanisms and as channels of transfer in high-priced, competitive market circuits.

To Clear the Channels

A common failure is shared by all these channels for technology transfer: much problem-solving takes place with little true transfer of technological know-how. This is the case, not only in direct investment or controlled flows from parent firms to subsidiaries and affiliates, but in many consulting contracts as well. Only rarely do contracts include measures to assure that the pertinent expertise is communicated to the client.

The "transfer" of technology is no neutral, value-free technical activity. It engages the values and interests of diverse actors in a competitive arena. Moreover, the objectives of buyers and sellers of technology are usually multiple and not all of them are in sympathy with the broader social goals of developing countries. If those goals are to be achieved, developing countries must formulate sound policies to make the technology transferred or developed consonant with social values and national objectives.

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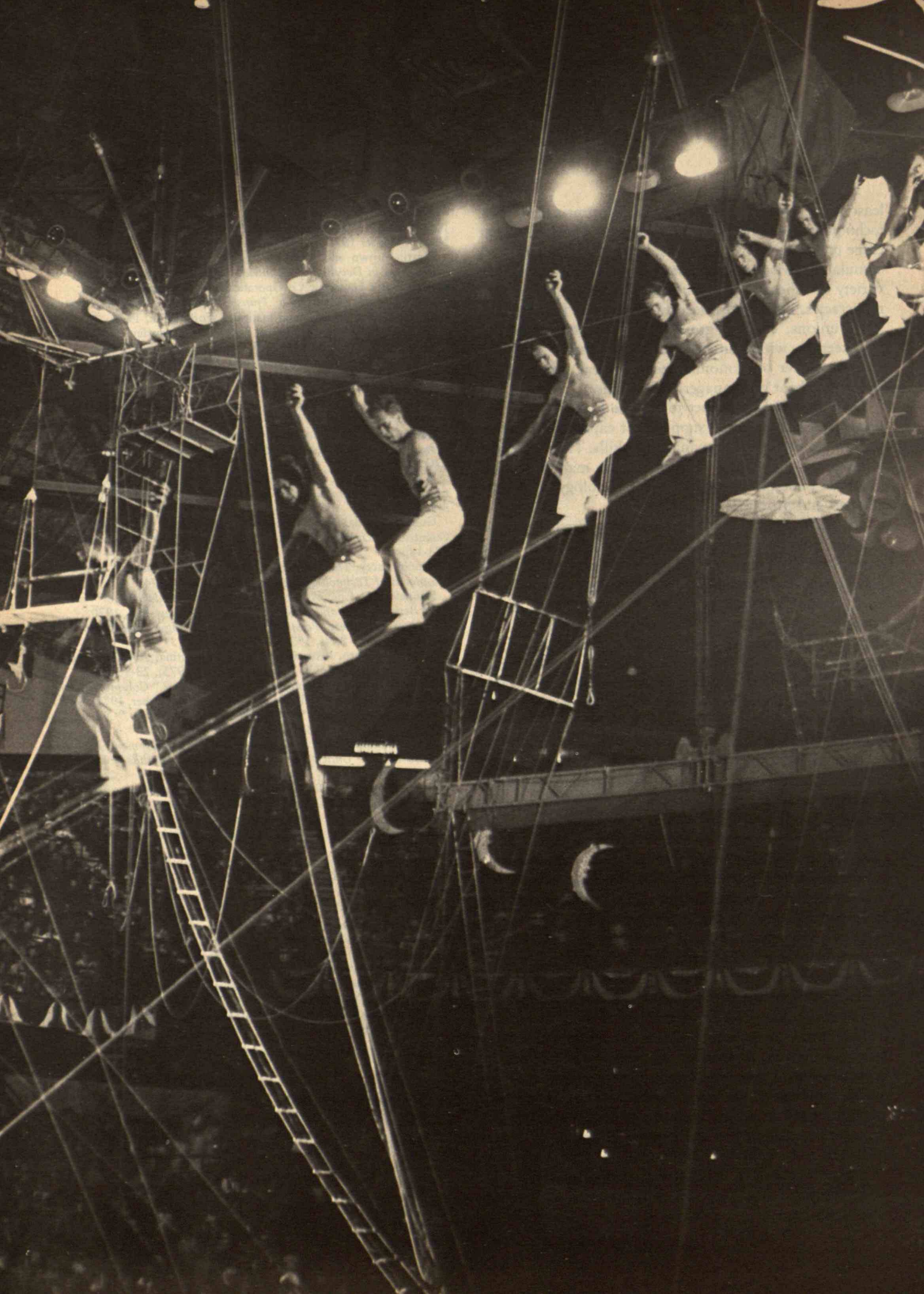
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Denis Goulet is Senior Fellow at the Overseas Development Council in Washington, D.C. His master's degrees in philosophy and social planning and Ph.D. in political science are from the University of Sao Paulo. He has taught in the U.S. at Indiana University and the University of California at San Diego, and is author of five books on the effects of development in Third World countries. This article is adapted from his book, *The Uncertain Promise: Value Conflicts in Technology Transfer*, New York: IDOC/North America, 1977.



Man's Internal Navigation System

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The comparison of guidance systems in technology with those in nature suggests a large number of parallels between the two.

Left: Three tasks facing the human inertial guidance system — stabilization, control, and guidance — are exemplified in this stroboscopic portrait of a high-wire artist. The photograph was taken by Harold E. Edgerton, Institute Professor, Emeritus, at M.I.T.

When a modern airliner or large ship “loses its way,” the consequences are news — often disastrous news, as in the case of the *Argo Merchant*, which ran aground on the shoals of Nantucket, or the *Amoco Cadiz*, which broke up more recently off the coast of Brittany. When a human becomes lost in a strange city or in the woods at night or on the way to the door in a dark hotel room, or becomes disoriented in an amusement-park ride, the consequences are recognized as a failure typical of our internal guidance system. The plane or the ship has multiple and redundant sources of information to help navigate, even in the fog or out of sight of land. So does the human. We do not have radio-frequency distance-measuring equipment, but we do have, in common with ships and planes, optical tracking devices, inertial navigation systems, and some rudimentary air- and ground-speed sensors. We also share the ability to do a limited amount of “dead reckoning”; we keep track of changes in position on the basis of the number of paces and their direction. Further still, we both possess the computational ability to estimate position from several parallel sources, each contaminated with noise, and perhaps containing conflicting cues. Finally, we possess the ability, only achieved in the most advanced technological guidance systems, of self-repair and of learning to use damaged sensors in a new way or to respond to combinations of signals appropriate to some bizarre environment (usually man-made). Despite all this ability, we commonly get lost. We become dizzy or nauseous when we spin. We get motion sick when reading on a bouncing bus. We stumble when we miscount the number of steps in the cellar stairs. What is it about the human guidance system that causes it to fail us in such very predictable ways?

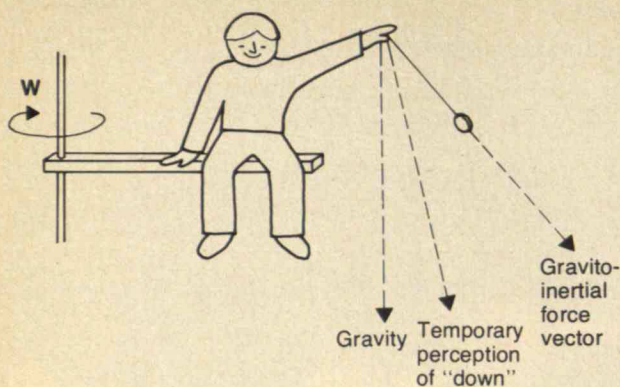
Semicircular Canals

By human spatial orientation, we refer to a geometrical quantity — a multi-dimensional vector — representing the perception of linear position and angular orientation

as well as their rates of change. The vector contains an answer to the question “Where am I and where am I going?” In addition, it answers the further questions: “Which way is down, and am I falling? Which way am I pointed, and how fast am I turning?”

The information encoded in the orientation vector is used at three levels of feedback, corresponding to the ship or aircraft autopilot roles of stabilization, control and guidance. The *stabilization* task is most clearly seen in the maintenance of eye position relative to a target or to inertial space, despite disturbances arising from body motion or vehicle vibration. Were it not for this stabilization, images would bounce about crazily upon the retina of the eye each time our head moved. (A patient with a disorder affecting his eye stabilization described the world as looking like the jumpy home movies taken by an amateur walking with the camera strapped to his chest.) The *control* task involves regulation of posture during standing or locomotion. We do not maintain our stability by standing like tin soldiers — our biped platform is too small and the effort would be too tiring. We must control the compound inverted pendulum which represents our body, hinged at the ankles, knees, hips, and neck, by continuous control of postural muscle groups. In addition to pre-programmed control to avoid falling during voluntary actions like getting up or jumping, the control system regulates against the effects of unexpected external disturbances, such as tripping over a loose board. Finally, the *guidance* task keeps track of our position in space and the direction to our objective, be it the surface of the water, home, or a road intersection.

To understand how the orientation system functions, it is necessary to appreciate the orientation sensors, or instrumentation, within our bodies. Prior to the mid-19th century, it was felt that the “sense of balance” resulted from shifting blood in the head or viscera or from pressure receptors in the skin. Recognition of the importance of the inner ear in spatial orientation was reported as



A conflict between two types of vestibular input is demonstrated by the experiment shown in the illustration. A subject is seated at the end of a centrifuge arm. The centrifuge is accelerated until it attains a constant angular velocity, ω . The true force of gravity remains downward, of course, but an additional force acts on the subject due to his centripetal acceleration. The result is an inertial force vector due to the combination of gravity and inertia — a vector that points in the same direction as that of the pendulum that the subject holds in the drawing. In the first few seconds of the steady-state rotation, the subject characteristically reports that “down” is in a direction intermediate between that of gravity alone and that of the actual, gravito-inertial force. In perhaps a minute, however, the subject’s perception of down comes to coincide with the direction of the gravito-inertial vector. The explanation of this delay is evidently that one type of sensor in the inner ear — the semicircular canals — have detected no roll acceleration, while another — the otoliths — have responded to the new acceleration vector. The reports from the latter were discounted in the first few instants of the steady-state conditions.

early as the late 18th century by the eminent physicist Venturi in Bologna. However, the difficulties encountered in reconciling a “spatial sense” with the then current philosophy of Kant (which denied any internal representation of external reality) prevented the importance of the inner ear from being recognized for many years. As late as the end of the 19th century, Cyon still fought to overcome resistance to the idea that the sense of time or space could be based on physiological transduction of physical variables. Only after Flourens in France (1842) demonstrated the postural instability of animals with the inner ear destroyed, and Goltz recognized certain special anatomical features of the inner ear, was the non-auditory part of the inner ear, the vestibular system, recognized as the “organ of equilibrium.” Even then, the precise mechanisms were not understood for many years. Breuer in Vienna and Crum-Brown in England worked on the means by which the semicircular canals, narrow, fluid-filled ducts of the inner ear, could transduce head movements. Ernst Mach, Professor of Experimental Physics in Prague from 1867 to 1895, found, along with Breuer and Crum-Brown, that the semicircular canals were angular acceleration transducers. Building on his formidable achievements in fluid mechanics, however, Mach showed analytically and experimentally that the fluid in the canals barely moved during head movements, and that angular accelerations were transduced instead by the pressure gradients they produced. In the 1930s

Steinhausen demonstrated that a gelatinous wedge called the cupula seals each of the canals to prevent continuous flow. Until recently, it was thought that the cupula rotated through large angles, like a swinging door, to signal head movement. Oman showed theoretically, however, that only minute pressure differences and cupula displacements should normally occur, in agreement with Mach’s view that the transducer is best described as a pressure sensor. This view has very recently received direct experimental verification by Oman and Frishkopf of M.I.T., along with Goldstein of Johns Hopkins, as well as by Klinke in Berlin and Hillman and McLaren of Iowa.

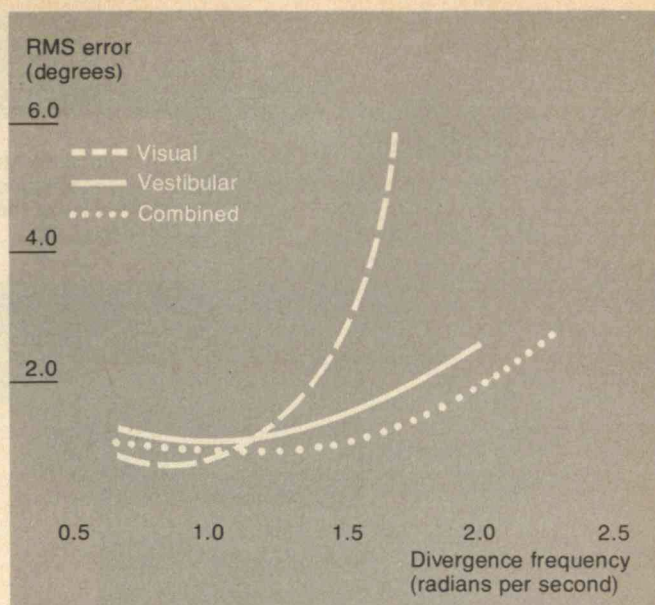
The semicircular canals are stimulated by the angular acceleration of the head with respect to inertial space, causing the ring of fluid in the toroidal duct to lag slightly behind the canal, just as the water in a drinking glass lags behind the glass when the latter is suddenly turned. (If you doubt this, spin a bowl of soup, and watch the croutons lag behind the bowl.) The mechanical properties of a viscous fluid flowing through a very narrow duct make the canals act more like “integrating accelerometers,” however, which is to say that their output is more nearly an indication of angular velocity than of angular acceleration for most of the frequencies of head movement involved in normal activities. Eye stabilization and our perception of rotation accordingly is based upon interpretation of the semicircular canal signals as representing angular velocity. In fact, when the frequency of stimulation is so low that the canals are in their “accelerometer range,” we are led to experience some common illusions, including the sensation of flying “straight and level” when our airplane takes a long and continuous turn in the clouds or the sensation of spinning in the opposite direction when we are stopped after having been whirled about for a minute or so. The three semicircular canals in each inner ear are oriented at nearly right angles to one another. This permits us to sense angular velocities about any axis. The dynamic characteristics of the semicircular canals also explain the disturbing and unexpected response during “Coriolis stimulation,” or cross-coupled angular acceleration, which occurs when the head is tilted out of a pre-existing plane of rotation. If, for example, one is being rotated with eyes closed at constant speed to the left in a swivel chair and tilts one’s head to the right shoulder, the experience is a sudden sensation of also tipping forward. (Hold onto your chair if you try this.)

The Otoliths

Whereas the semicircular canals are admirably suited for sensing angular accelerations, they are relatively insensitive to orientation of the head with respect to gravity, and their estimates of angular velocity are not sufficiently accurate to enable the estimates to be integrated to keep track of head orientation, as would be done in the analogous case of integrating the information provided by gyroscopes in a gimbal-less inertial guidance system. Accordingly, the inertial sensing of orientation relative to gravity is performed by other specialized portions of the non-auditory inner ear, the utricular and saccular otoliths. These specialized linear accelerometers contain a

gel filled with dense calcite crystals called otoconia. This denser mass "slides downhill" over a bed of specialized receptor cells when the head is tilted, and signals from those underlying cells indicate the angle of tilt. Ernst Mach became interested in the inertial sensing properties of the otolith system when he noticed that the trees and houses on the side of a railroad track appeared to be tilted when the train in which he was riding went around a curve. He concluded, correctly, that the inertial balance organ accepts the net acceleration vector resulting from gravity and inertia — the latter in this case corresponding to the train's centripetal acceleration around the curve — as its overall reference. Later investigations clearly validated this concept and indicated how the otoliths act in three dimensions to detect, on the one hand, sudden linear accelerations associated with head movement and, on the other hand, our steady-state orientation with respect to what is presumed to be the gravity vector. A simple example of the ambiguity which results from assuming that the steady pull on the otoliths is in the direction of gravity is the sensation that we experience during aircraft acceleration down a runway. Even before nose-up rotation, we believe that the airplane is pitching upwards. In reality, we are simply being forced back into our seats, and the rotation of the gravito inertial acceleration vector is sensed by our otoliths (and misinterpreted thereafter). Some more bizarre illusions, also more difficult to understand, appear during free fall, as experienced in orbital flight by astronauts. Lacking any net gravito inertial vector to stimulate the otoliths, the astronaut's inner ear yields no steady orientation information. Nevertheless, every head movement produces a transient acceleration vector which stimulates the otoliths, and might be misinterpreted as an orientation cue with respect to some phantom "down."

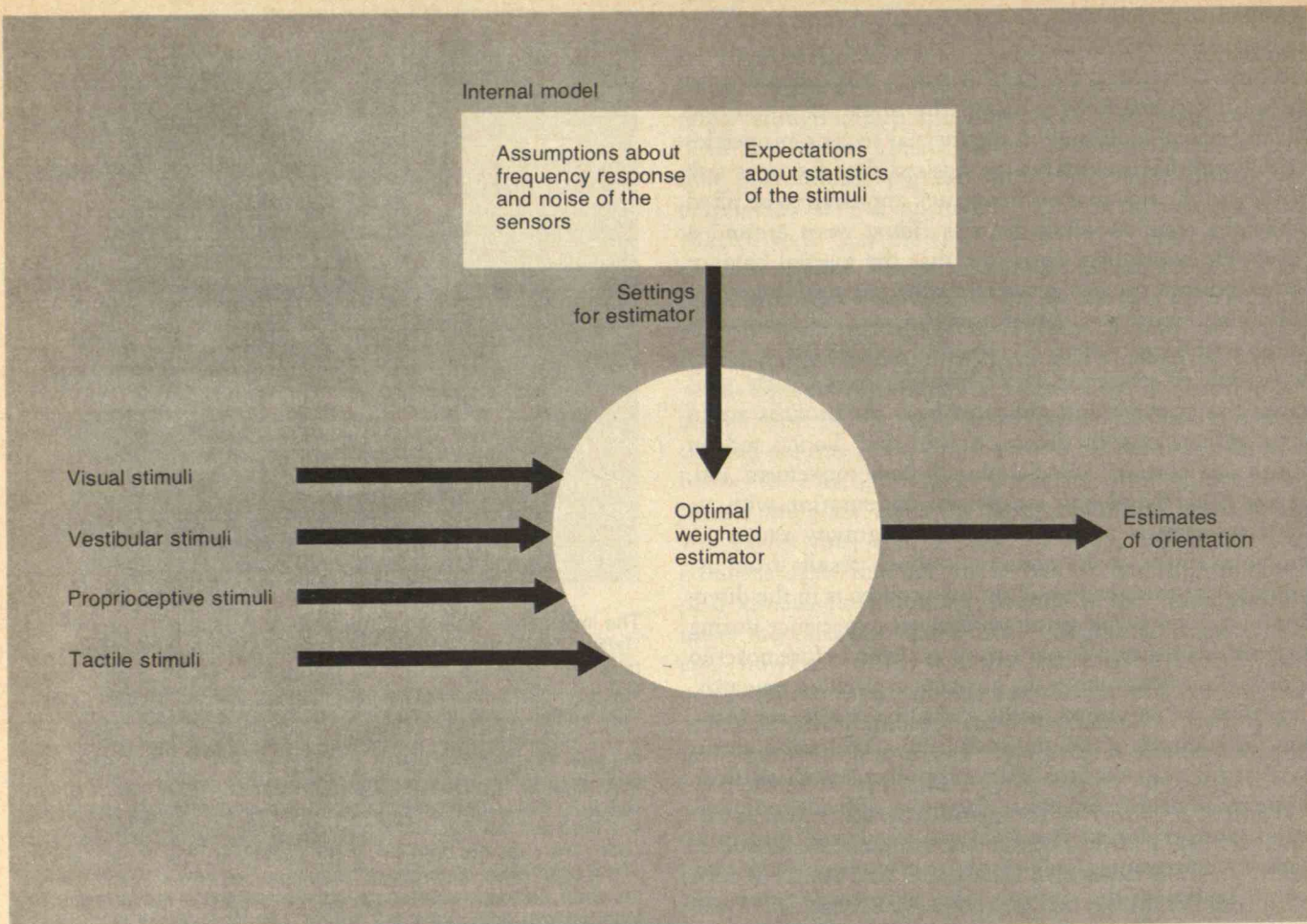
The two elements of the vestibular apparatus — the otoliths and the semicircular canals — normally act in harmony, so that angular rates detected by the semicircular canals are reflected in new head orientation to the vertical, as also sensed by the otolith accelerometers. When subject to unusual motion, however, such as is usually associated with man-made vehicles, the two systems may yield conflicting information. In such cases, the orientation-estimation system must either combine the conflicting signals or choose to ignore one of the signals for some period of time. (The development of such sensory conflicts is the cause of motion sickness according to the now-popular "conflict theory" of the malady; by the same token, the sensory rearrangement required to reinterpret the signals is said to be the basis of motion habituation, or getting one's "sea legs.") One example of a conflict between the otoliths and the semicircular canals is the case of a subject seated in a fixed chair on the end of a centrifuge arm. When the centrifuge spins up to a constant speed, and the angular and tangential accelerations have returned to zero, the subject is left with a lateral component of centripetal acceleration which, when combined with gravity, results in a gravito inertial vector that is tilted and also increased in magnitude. This new vector direction is accepted as "vertical," and the subject



The importance of vestibular and visual cues in the correction of "falling." All three curves derive from the same experimental paradigm: equivalent to a chair attached to the top of a pole, much like a weight in an inverted pendulum. In one set of experiments, the subjects watch the chair and attempt by remote control to bring it to a vertical position and keep it there; their cues in performing the task are therefore visual alone. In another set, the subjects attempt to do the same, but this time they are seated upon the chair with their eyes closed; their cues are therefore primarily vestibular. In a third set, the subjects are seated in the device with their eyes open. The cues are both visual and vestibular. The horizontal axis of the chart plots "divergence frequency," ω . Low ω 's, at the left of the chart, correspond to long pendulum lengths — that is to say, to long balance poles; high ω 's, at the right, correspond to short pendulum lengths. In general, then, the results conform with the truth that balancing a broomstick vertically is easier than balancing a pencil. More specifically, though, low ω 's give results that are much the same for vestibular and for visual cues. At higher ω 's, on the other hand, visual cues alone are markedly less useful than vestibular cues alone. In fact, the vestibular cues are almost as useful as visual and vestibular cues combined.

feels tilted to the side. Yet the semicircular canals indicate *no* acceleration, in conflict with the otolith-sensed tilt. The experimental results of Graybiel and Brown show that an extraordinarily long time, on the order of a minute, is required to permit the new steady-state tilt to be adapted in this unusual situation.

The complex processing in estimation of orientation based upon multiple inputs has been modeled. One model assumes that the estimator is "optimal," in the sense that it yields a single orientation vector taking into account both the response time of each sensor and the assumed signal-to-noise ratio on each input channel. In another model, a "gate" is included, so that one input channel can be "shut off" temporarily if its information is grossly mismatched to a complementary signal from a sensor which is more reliable in the given frequency range. Thus, for example, the delayed acceptance of the gravito inertial acceleration as "down" in the centrifuge tests mentioned in the preceding paragraph is accounted for by the model, which "ignores" the otolith cues in the short term when they conflict with the signal from the semicircular canals



A model for estimating orientation based on perceptual stimuli. The stimuli take four forms: they derive from visual cues, from sensors of attitude and acceleration within the inner ear, from sensors of position within muscles, tendons, and joint capsules, and from contact of the body with objects in the external world. All serve as inputs to an estimator, but not equally so, for the values of the various data are weighted. In particular, the overall model includes an "internal model," which embodies assumptions about the

frequency response and noise of the various sensors; after all, a particular sensor may be more reliable for one frequency of motion than for another. Moreover, the internal model embodies expectations about the statistics of the stimuli. That is to say, it makes extrapolations, for some positions — say a sudden, discontinuous change — are unlikely in light of what previous motions have been.

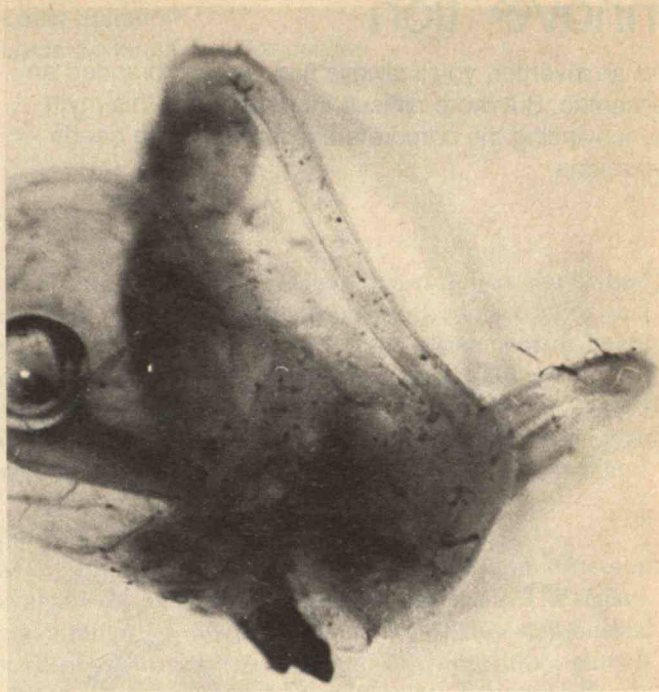
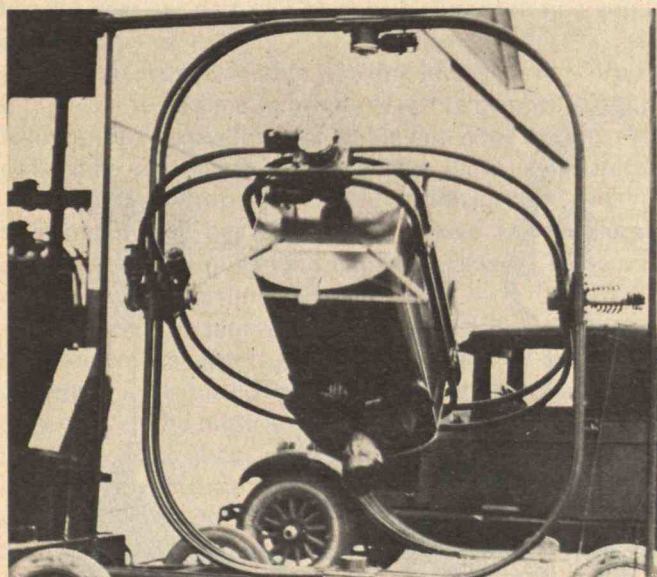
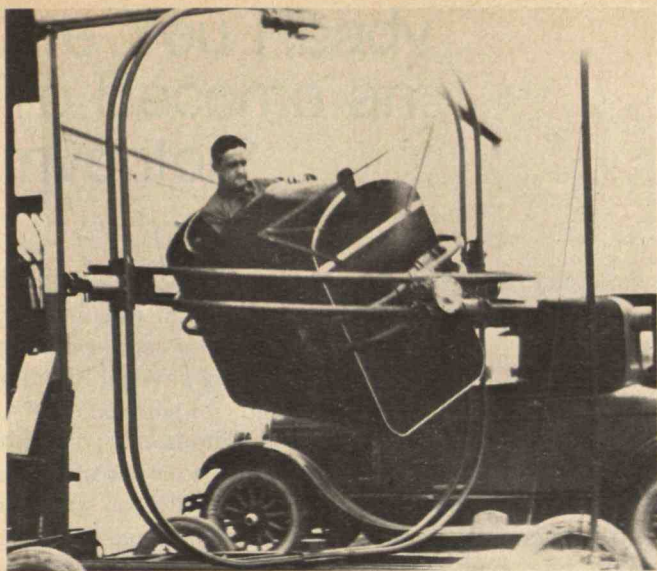
indicating no rotation. After a minute or so, however, the otolith graviceptor information is accepted as the steady-state indication of the vertical.

The Correction of Drift

We have already mentioned several parallels between biological and technological guidance systems. Several others remain. First of all, the inertial guidance system of a ship or plane requires external inputs both for setting initial conditions and for periodic updates as to actual position and orientation with respect to the earth. Similarly, our internal guidance system, although capable of reasonably accurate inertial navigation for minutes at a time, based only on cues from the inner ear, will eventually drift badly unless other external information — usually visual — is available for resetting. The drift characteristics of vestibular orientation are well known anecdotally from tales of lost hikers walking in circles or aviators without instruments slowly spinning into a "death spiral" in the clouds. There is also our tendency to rotate slowly when marching in place with eyes closed. The

low-frequency inadequacy of unaided vestibular information is readily seen in postural control as well. Try standing erect with one foot directly in front of the other, arms akimbo (the "sharpened Romberg position" of vestibular testing). When the eyes are closed, balancing becomes much more difficult, and the tendency toward low-frequency oscillation and loss of balance is marked. Evidently, visual cues play an important role in the human orientation system.

Second, all instruments drift. Gyroscopes have drift errors which depend on acceleration, for example. Elaborate test procedures are used to estimate their error coefficients and to compensate for their effects in flight. Similarly, "errors" in the semicircular-canal measurements of head velocity would lead to inappropriate eye stabilization or postural control if they were not corrected. Fortunately, a flexible error-correcting mechanism exists in the animal orientation system: it uses visual input to compensate for any inadequacy of the vestibular system. If the relationship between head movement and visual-field motion is altered, as by wearing reversing



Above: A portion of the inner ear involved in the sensing of position and orientation is shown in this dissection from the head of a frog. The bony covering of the sensors has been removed, leaving the sensors themselves exposed. All three of the so-called semicircular canals appear in the photograph; each is a fluid-filled, membranous tube. One of them, sharply in focus, is arrayed diagonally in the photograph; a second appears almost horizontally at the right of the photograph; and the third, here lying behind the other two, is beyond the photograph's depth of field, and thus is out of focus. The three are arrayed at nearly right angles to one another, which permits them to sense angular accelerations of the head about any axis. (Photo: Professor Charles M. Oman, M.I.T.)

Left: C. S. Draper, the father of inertial navigation (and Institute Professor, Emeritus, at M.I.T.), in an early pilot disorientation trainer at Brooks Field, Texas, in the 1920s. Disorientation during flight has been a problem since the earliest days of instrument flight. The most current example is the "space motion sickness" experienced by astronauts. (Photos: M.I.T. Historical Collections)

prisms, for example, Melvill Jones has shown that vestibular nystagmus (the sawtooth pattern of eye movement that compensates for head motion) also is eventually modified so that the eyes are driven in a manner more appropriate to the new stabilization requirement. An even more dramatic "self-repair" is evident after the destruction of one vestibular inner ear — a not uncommon procedure in otolaryngology. The immediate effect is a strong bias toward one side of the body, reflected in nystagmic eye movement, postural adjustment, head tilt, and spinning sensations. Nearly complete restoration of normal reactions and elimination of the bias follows a period ranging from hours in the guinea pig to days and weeks in the cat and months in the human. The process of self-repair appears to be one of central compensation for the bias, based upon visual information, and reliance upon the use of the remaining labyrinth for bilateral rotational sensing. Even the loss of both inner ears can be largely compensated by increased reliance on visual and other cues, including the positions of the joints. Although it seems difficult to believe, there are even reported cases of

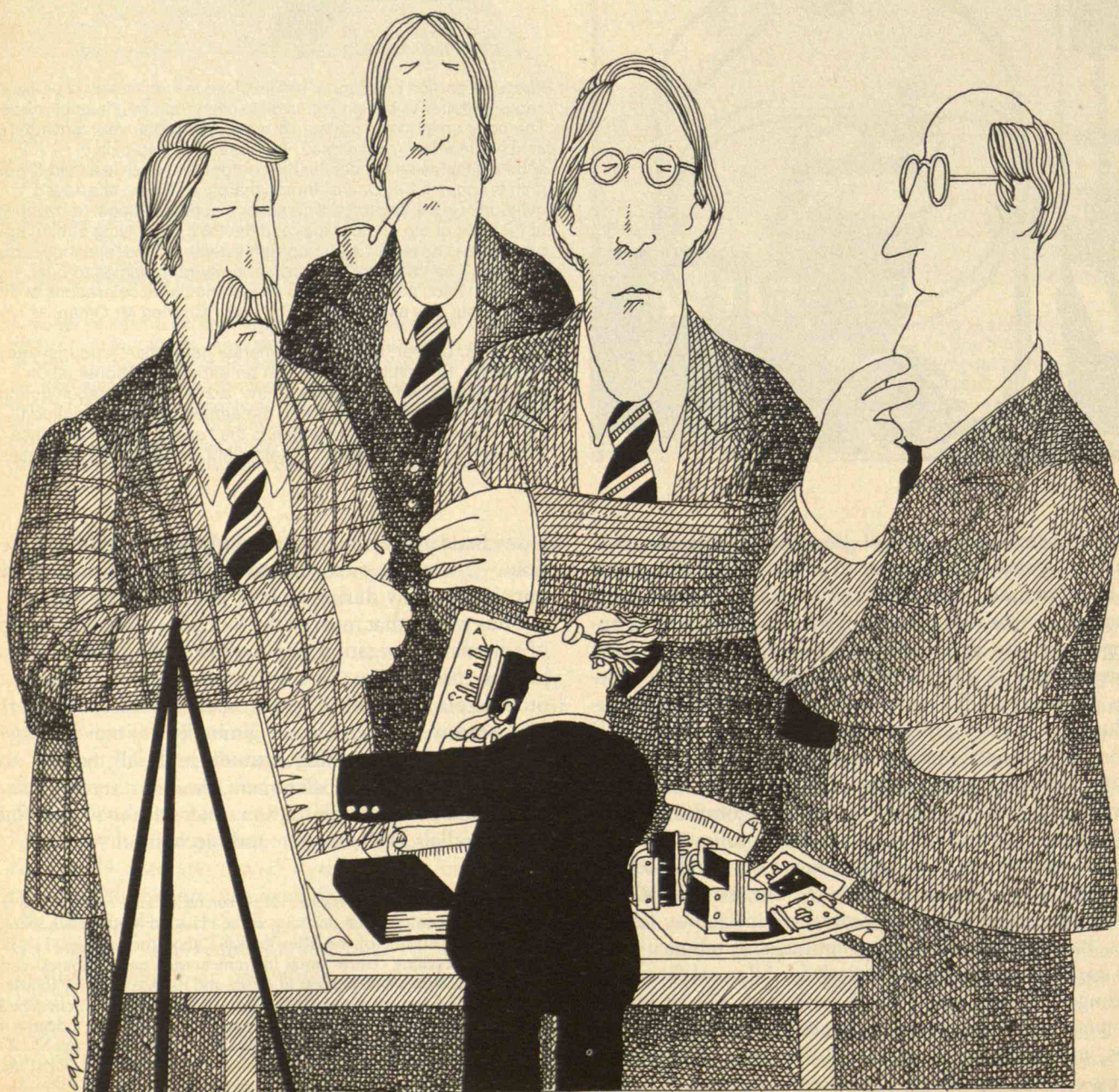
individuals unaware of their total lack of vestibular function — including one aviation cadet who learned of his impairment only during a Navy physical examination.

Thus we see that most of the functions and components of automatic navigation systems have their parallels in the human orientation system. Semicircular canals and otoliths play the role of gyroscopes and accelerometers. The head is stabilized like a gimbaled inertial package. Visual inputs concerning attitude and self-motion are analogous to optical alignment, horizon sensing, and radar. Adaptation, habituation, and self-repair: all find their parallels in the human and mechanical systems.

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Innovaha! tion

As an inventor, you'll always find yourself branded an eccentric. But more difficult than dispelling this myth is convincing the corporate executive that he needs your idea.



Illustrations: Cameron Gerlach

Are You Ready To Become an Inventor?

Louis Soltanoff
Louis Soltanoff and Associates

When I am at a party and a stranger learns that I make my livelihood as an inventor, he or she invariably stares sympathetically at my wife. That look means, "How did a nice girl like you get involved with a nut?"

It is one thing for someone you meet at a party to react this way; it is another if the people you depend upon for assignments have similar prejudices. And executives in industry do. They find it hard to accept that a sensible graduate engineer would prefer the uncertainties of this profession rather than the steady paycheck and fringe benefits that are part of a responsible position in a good company.

So if you are considering rejecting life under the corporate shelter to become an inventor, just remember that the fellow sitting across the desk whom you hope to convince to become your client has misgivings about your sanity. Thus, one of your earliest and most difficult tasks will be to communicate not only your creative and technical capabilities, but your sound judgment as well. These are not antithetical qualities.

Of course, the moment you become rich and famous the problem disappears. At worst, you will be fondly regarded as a quaint eccentric. But eccentricity is not the only or even the most important reservation a manufacturer may have about contracting your services. He can live with that. He cannot tolerate, however, an individual who is uncompromising and lacks understanding of the total innovative process. Invention is only one segment of that process. The rest of the process involves organizing to produce and market the product. The last thing a company executive needs during the production and marketing of a product is an irascible inventor to contend with. So until you achieve success, you will have to reassure the potential client that you possess both the professional and character credentials that will enable you to work together in a harmonious and effective relationship.

While he may accept the fact that your choice of profession makes you "different," he must be satisfied that this difference will not be a cause of irritation. He would like you to be reasonable during negotiations, respectful of company procedures and sympathetic to the demands that his operational responsibility places upon him. In his scale of priorities, the here and now of company survival through profit generation takes precedence over the future benefits of a new product program.

There is another complication to your ambition. While companies recognize the need for expert counsel from lawyers, economists, architects, and accountants, the need for a consultant to supply innovative products or process improvements is not generally recognized.

As a professional inventor, then, you are faced with two difficult tasks. The first is to convince a potential

client that his need for creative new products can be best resolved by an independent inventor; and secondly, that you are the best individual for the assignment. It is not enough to believe that you are creative, knowledgeable and possess sound judgment. You must be able to convince the client during an interview that you indeed possess these characteristics. In short, you must be articulate.

No Diamond Will Seem as Costly

Many companies have instituted screening committees to evaluate the merits of new product proposals. The screeners attempt to assess the product against established yardsticks: market size, strength of competition, patentability, capital equipment requirements, for examples. As an independent inventor you may have a turn to try to sway such a screening committee. If you have been hired as a consultant, the chances are that your opinions will carry more weight, however undeservedly, than an employee's. That is one of the advantages of being an outsider. But do not believe for one moment that your idea is so good that its merits are self-evident. Not even the most expensive diamond will seem as fragile and costly as the project you are trying to convince the company to underwrite. So do your homework. Your object is to communicate, so use devices that aid in this purpose. Don't expect executives to understand orthographic projection; use three-dimensional sketches so that even a child can understand what you are talking about. Support your concept experimentally. Discuss the competitive products, their merits and weaknesses. Include estimates on manufacturing cost if possible. If they have the equipment in their shops to build the product, say so. If there is a good fit with their existing marketing or distribution organization, include that too. By all means make a cash flow analysis based on the achievement of a conservative share of the potential market within a reasonable time.

Present your proposal personally. Be prepared to play the role of advocate. Never, under any circumstances, send it through the mail to be reviewed and judged in absentia.

Unveiling the Executive Fantasy World

If you believe that companies eagerly support the development of new products, you will discover a far different reality. Despite your credentials, you will find that most companies will not jump at your offer to discuss how you could help them meet new product objectives. You disturb them. They prefer their immutable picture of the world in which there is a perpetual demand for their existing product lines, a satisfactory share of the market and a healthy growth in sales and profits. It is a fantasy world in which technical obsolescence never occurs and

the competition prices their products fairly.

While most companies cannot be described as being innovative, a few are. These few are sufficient to keep our profession busy. Your problem, of course, will be to locate them.

If We Don't Succeed, We Don't Eat

You may think it presumptuous to believe that you can help a major, multinational company achieve its new product goals. Of course you can.

The strength of such companies is not in their innovative ability but rather in their capability to produce and distribute products competitively. They do this by being capital intensive, structured, disciplined and specialized. These are the very qualities that inhibit the entrepreneurial, non-structured, risk-taking and creative spirit required for invention.

Some progressive companies understand this dilemma and try to solve it by creating an environment for a special group that has a freer hand. However, this environment lacks the special incentives that motivate the individual inventor. (Compensation for success or failure must be buffered from the real world lest it fatally stress the relationship between this elite group and the rest of the company.) So one powerful incentive that is typical of our way of life is missing entirely from theirs. That is, if we don't succeed we don't eat. In their environment, the paychecks are issued weekly, regardless.

Further, you must keep in mind that there is an inverse relationship between size and creativity in the art of invention, just as there is in other art forms. You would regard it as preposterous for a large corporation to claim that it can write a better play or novel than an individual by virtue of numerical superiority. Thus, any major corporation is a potential client for your services.

If you find it difficult to find a company interested enough in your new product services to hire you as a consultant, there is a different route to put bread on your table and new products in the marketplace. You may elect to establish a small company to develop, manufacture and market your concept — presuming, of course, that you have one that you believe can be readily commercialized. Many successful companies have been founded this way.

The Paths to New Products

I'll assume, though, that you do not wish to become a businessperson and are steadfast in your resolve to become an independent inventor. In that case, you should be familiar with the several other options open to a company executive searching for new products. You are just one of the several paths down which he may elect to travel.

The executive will probably start his search within his company. He will discover that most of the patents issued to company employees are for refinements to the company's existing product lines. Rarely can these promise an exciting concept for a new product. This is not surprising. In most companies, there are no substantive rewards for an employee who makes original contributions. Even without a reward, creative employees frequently find the company's interest in novel concepts so minimal that they generally do not bother to submit them.

In many companies, particularly in the pharmaceuticals and chemicals industries, the research and development departments are traditionally considered the source of new products. More often, however, they develop specialized staffs with a narrow directive — to improve the company's competitive position through improving the performance and reliability of existing product lines and reduce the manufacturing cost through material or process changes. These companies badly need an infusion of new ideas from an outside source.

Every company receives a flood of unsolicited ideas sent in by consumers whose products they are familiar with. The suggestions are handled gingerly and processed carefully because they are recognized as a potential source of lawsuits. Each must be logged in, acknowledged, reviewed and evaluated before a response to the donor is made. Rarely is a worthwhile idea submitted and it seldom justifies the maintenance of this expensive handling system. As an independent inventor, you must be careful not to have a potential client confuse you with this group.

Dry Wells Promote New Ventures

If the company executive has struck a dry well in his internal search for new products, he now can exercise an option for expansion which most companies prefer. That is, he can go out and buy a small innovative company, either by outright purchase or acquisition of stock. This is a way of acquiring the services of an outside inventor, once removed.

In this strategy, the acquiring company has bought into a supply of poorly financed start-up situations for which it can develop the technical, manufacturing and marketing organization required to bring an unproven concept to market.

There is a wealth of consulting firms which profess to have developed a special competence in innovation through the application of influential psychological principles. Several claim that under the guidance of one of their trained leaders a heterogeneous group can invent to meet the client's special needs. In fact, the more successful firms insist the day of the individual inventor is over.

To Start Entrepreneurship, Stop Change

Is entrepreneurship dead, dying, or even at risk in America?

Pessimistic observers say yes, with the government their favorite scapegoat — the source of inflation, the discourager of investment, the taxer of initiative's reward, the regulator of everything except the weather.

The government may be that much the villain and the entrepreneur an endangered species, admits Kenneth H. Olson whose Digital Equipment Corp. is one of the successes of American entrepreneurship of the quarter-century just ending. But there is "probably more entrepreneurial spirit and activity today than at any other time in our history" (excepting only a few years in the late 1960s), Mr. Olson told the National Academy of Engineering last fall.

Ralph Landau, founder of Halcon International, Inc., who joined Mr. Olson on the N.A.E. platform, agreed. As a part-time teacher of chemical engineering, Dr. Landau sees "how eagerly young people seek opportunities to go into business for themselves. . . . The desire to be an entrepreneur still flourishes," he said.

Both agreed, too, on their prescription for the future: our problem is not to concentrate on what we may have lost but to avoid negative thinking about what we have.

It's true that hazards on the way to successful entrepreneurship for today's engineer with a good idea are legion. Many come from the government, which Dr. Landau said imposes "excessive and unnecessary barriers to innovation." Among those cited by Dr. Landau and Richard S. Morse, who recently retired as Lecturer in M.I.T.'s Sloan School of Management:

- Over-regulation in the name of public safety, environmental integrity, and anti-trust, applied selectively to new enterprises while established businesses escape under "grandfather clauses."
- Selective taxation of "unearned" income and high taxes on capital gains, the fruits of entrepreneurship.
- Restrictive investment standards imposed on many pension and other funds.
- Deficit spending policies resulting in inflation and high taxes.

Actually, there is no basis for their claims. Although they have earned many millions over the past five years in fees from their clients, their record of distinguished innovative products is practically nonexistent. I regard them as a passing fad. Their psychological pretensions ignore the most important knowledge that we have about the creative process, namely, that it is highly dependent upon the individual subconscious.

There are several other sources for new products that deserve mention. General Electric, for instance, is one of several major companies that publishes a newsletter of products that are available for sale or license. Some uni-

□ Lethargic responses to proposals for research and development funding.

□ Concentration of research and development funds in government laboratories and "think tanks" in which there is little ability or incentive to successfully commercialize results.

There are other hazards, too — born of the complexity of technology and the sheer size of modern industry. There is "a national preoccupation with large systems," says Mr. Morse, and with large enterprises come rigidity, long-range planning and control, "risk control," and management by objectives.

Dr. Landau told the N.A.E. that his own industry is a victim of these trends. "I feel it is virtually impossible now to enter the chemical manufacturing business, except in the specialty areas where capital requirements are low, unless one is already a large company."

Mr. Olson is willing to put up with all these constraints if they're not accompanied by too much negative thinking. "In our society we discourage entrepreneurship by giving more value to the individual who criticizes than to the organization that does things," he said. "For example, we as a society are very interested in protecting the privacy of the individual, particularly if he or she has some criminal history. But there is no privacy at all for someone in business."

For a government intent on improving the climate for entrepreneurship, the key word should be stability. "People need a feeling of stability," said Mr. Olson; "the feeling that the rules are unstable is probably the biggest discouragement to investment."

"Above all else," said Dr. Landau, "business — large and small, but particularly the entrepreneurs — needs a higher degree of certainty [about the] general economic and legal climate: price controls, wage controls, energy rules, tax laws, regulatory rulings, and accounting principles. . . . There just must be some way that the businessman [and those financing him] can have reasonable assurances in advance of investing thousands or more likely millions in a product, process, or plant that he won't go broke after proceeding in good faith because the rules of the game change in the sixth inning." — J.M.

versities are represented by brokers who peddle the products of their faculty. N.A.S.A. is also out there beating the bushes for users for its products. And, of course, there are numerous independent brokers and newsletters offering their respective products.

In short, it's crowded out there. There is no dearth of new products looking for underwriting and development. What is in short supply are products that are suitable for your client — those products which will uniquely satisfy his capabilities, financial and technical resources and his ambitions. That is how you, as an outside inventor, can best satisfy your client.

Strategies for the Subconscious

The individual inventor should employ certain strategies to direct and stimulate the creative process. That does not mean that these strategies are a mechanism for creating new products; they are rather a means for directing or stimulating your creativity. One help is to have the department heads of a firm agree on the specification for a hypothetical new product. You will ensure, not terminate, the program by delivering a product that one of the department heads will shoot down as being inappropriate to his needs and capabilities.

How do you do this? I describe a product that the firm's representatives will be familiar with to stimulate discussion. For instance, one of my clients manufactures material handling equipment — roller chain, bearings, linkages. The company's manufacturing strength was strictly in the metalworking area. I gathered the department heads and told them I had invented a product called a roller skate. The head of manufacturing thought it was a great product. Engineering was not overwhelmed. The head of marketing vetoed it despite the fact that it was patent protected and had a large potential market. The toy market was alien to his experience and he doubted they could develop competence in it. They then all agreed that any new product I came up with had to be suitable for their existing industrial and agricultural markets.

I then described an agricultural product made essentially of plastic parts, and I wanted to test how much weight they gave to their manufacturing know-how. They were not interested in this new product criterion.

If I had not undertaken this demonstration, neither they nor I would have appreciated the boundaries of product acceptability. I could have tailored my creative effort to produce a product suitable for their manufacturing capability when in fact it was not desired.

There is a further benefit to this exercise. To stimulate your creativity you must artificially reduce the number of new product directions you intend to explore. Having a universe of choices is less helpful for the creative process than a few options. The constraint of a hypothetical specification for a new product offers an important creative stimulus.

Another device I use to stimulate my creative thinking is to invite a mixed bag of people — laymen as well as professionals — to discuss and relate to the client's problems, ambitions, and capabilities with new product specification. I hope occasionally to hear about an emerging technology that could be explored. Mainly I gain a new point of view because I cannot help but be limited by my own background and prejudices.

All of us, having studied the same books, tend to stand together on the same peak looking down at a set of problems. Thus, we often see the problems the same way. Our

object should be to find our own peak away from the crowd. When we do and we look at the problems from a different vantage point we may see them very differently.

You Are Now Ready To Solo

From then on, you are on your own. If you are unfamiliar with the client's industry, I recommend the editors of the trade journals in that industry for an overview. You might also want to contact the industry and professional associations. Your objective should be to familiarize yourself with the lore. But not to accept it.

It may seem odd to you that any company would hire you as a consultant to create a new product if you are unfamiliar with their industry. If you have a sound technical background there is no reason why this should be an obstacle. In fact, it is an advantage. It is more likely that someone outside their industry will make a breakthrough contribution than someone in it. Two examples: both the instant picture, Polaroid, and the color picture, Kodachrome, came from amateurs outside the industry.

Because you are not a specialist in their field, do not attempt to help them improve their line of widgets. Product improvements are best handled by the experts with industry experience. Your special contribution will be to create a better widget with unique and improved principles. Your objective is a patent-protected viable market.

To give you an idea of the variety of projects you can get involved with, consider a few of those I have worked on during the past ten years: a new concept for refining wood pulp, an automatic telephone dialer, a bolt pre-load indicator, an instrument for measuring the height of fluent solids, a retail gasoline telemeter, and an airline baggage identification system.

I believe that inventors are an integral and valuable part of our industrial infrastructure. They are an important national resource, which is seldom properly exploited. Further, I believe that the joint collaboration of the inventor and his sponsoring company is the most fruitful avenue for that exploitation. Industry should encourage suitable talent to enter this profession by actively engaging their services in programs of innovation. If this is done, I believe there will be an important resurgence of technological leadership in the country.

Louis Soltanoff received his B.S. in mechanical engineering from Rensselaer Polytechnic Institute. His first company was a design/construction firm. Much of his later career was spent in engineering; first as a designer of hydro-mechanical products, and later he became Chief Engineer for the New York World's Fair Monorail and the Atlas and Talos Weapon Handling Systems. In 1969, he founded his consulting firm, Louis Soltanoff and Assoc., to guide companies in new-product innovation.

How to Put Technology Into Corporate Planning

Alan R. Fushfeld
Pugh-Roberts Associates

Every executive knows of corporate successes in which technology has played a dominant role. Almost everyone in venture capital and entrepreneurship has a personal list of these successes to emulate. Dreams of technology turned to profit are nurtured by real-life success — Intel Corp., Minnesota Mining and Manufacturing (3M), Polaroid, Hewlett-Packard, and Digital Equipment Corp., to name a few of many.

Despite the obvious role of technology in superlatively successful enterprises, technological issues only occasionally are included explicitly in typical corporate strategy reviews, and only rarely are they among the regular inputs to corporate planning and development.

Technology: The Underutilized Input to Planning

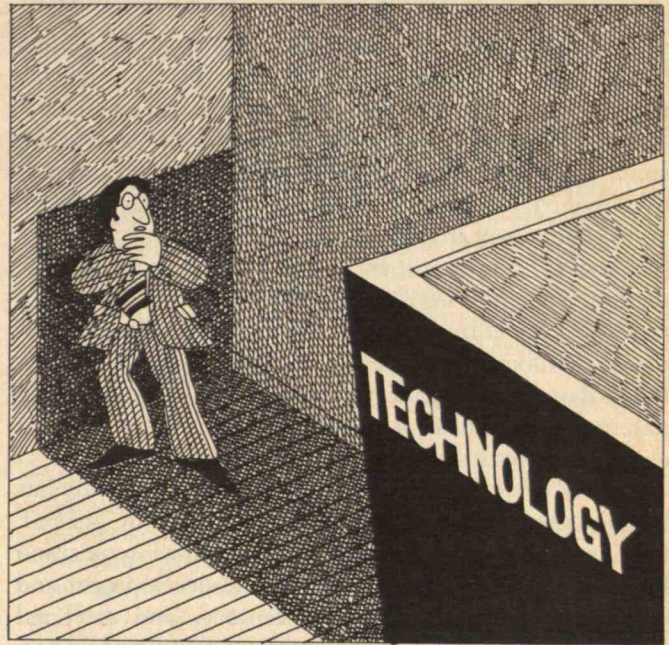
Most executives have limited management experience with technology. They see research and development as a black box: money and manpower resources are put in, but what should come out? How should these resources be directed and managed? And what should be the characteristic delays, success rates, and managerial control variables? General business management lacks an intuitive feel for strategically directing and positioning research and development investments as compared with similar investments in marketing, sales, and manufacturing. The result is that technology issues tend to be downgraded in overall importance to the business. Technology is addressed in strategic plans only implicitly, except in the case of special endeavors which are outside the main lines of production — new and joint business ventures, licensing, and acquisitions. In these, technology cannot be overlooked; it is often a major ingredient and even rationale in a purchase or joint venture plan.

In general, key management decisionmakers have inadequate background and ability to make judgments and forecasts in the area of technology. Without that ability, their options in utilizing technology in corporate strategy are severely limited.

There are many reasons for this blindness to technology and its management in our traditional administrative practices:

- Most managers have been trained and have made their successful contributions in marketing, manufacturing, law, accounting, or some other corporate function. Their limited training in science or engineering is not enough to give them confidence in dealing with technological change.

For similar reasons, corporate economists fail to recognize the process of technological change in their economic forecasts. They either consider all products as homogeneous or see technological change as a wildcat input to their processes — something that comes from



heaven or not at all.

Market research, too, has drawn very little on the technological field. Market researchers typically focus on short-term perspectives. Good, future-oriented market research should provide information that puts together a corporate strategy involving a realistic contribution from technology.

- We know very little about the process of technological change; the knowledge we have is new (accumulated in the last 10 to 15 years) and has yet to be synthesized.

- Partly due to limited experience, we lack adequate frameworks for viewing technological change. There is nothing comparable in this field to the simplifying frameworks for strategic business planning which have become prevalent in the last decade. The management of technology is, in fact, the only functional area which is not represented by a discipline within any management school.

- Technological change proceeds slowly: significant change requires five to ten years. This time span meshes poorly with the planning objectives of most American corporations. Although most corporations have five-year plans, 90 per cent of their research and development activities are designed to be implemented within three years, and the remaining 10 per cent within four years. Most corporations outline their strategic objectives on the short time horizon enforced by their need to manage short-term cash flow needs. That's not a time horizon appropriate for significant technological change.

Most research and development objectives are biased

Technology is an overlooked stepchild in most corporate planning. Here is a plan for analyzing technical strengths and weaknesses which puts technology on a par with manufacturing, marketing, and sales in the competition for corporate resources.

toward existing needs — such as defensive goals as product improvement and cost reduction. This bias toward the use of technology in the support role to implement strategic objectives planned for three or four years in advance is the obvious result when managers lack an intuitive understanding of any larger goal for their research and development investments.

□ Most U.S. corporations are organized around the production process. They are not organized to recognize or to reward the uncertainties, risks, and time constraints of the technological innovation process. Not surprising, then, that most significant technological change originates outside of the firm — or even of the industry — that eventually uses it.

In only three areas of strategic corporate planning has technological change been widely — and, in general, wisely — considered in corporate planning. Acquisition has been a major activity of corporate development and diversification in the last half-century, and expected technological change and the acquisition of new technology has usually been an explicit consideration in this area. Technology has also been addressed explicitly in the licensing area, and it is an implicit part of new venture activities. In all three cases technology is the essential element of the new opportunity.

Putting Technology in Its Place

Put yourself in the place of an executive assigned to set forth a corporate strategy. You must consider many elements — the broad characteristics of the industry, the qualifications of your firm's competitors in it, and your organization's corporate resources — managerial, financial, organizational, research and development, manufacturing, marketing, and distribution.

Technological issues enter as a result of activities both inside and outside the industry. They can affect the whole range of corporate activities: management, materials pro-

curement, manufacturing, marketing, financial results, and future growth through new products and into new markets.

As you begin your analysis of corporate strategy, ask yourself such questions as these:

□ How are technological issues recognized by your senior management? As a black box? As an input to long-range planning? For meeting short-term objectives? How explicit is the recognition of technology in each of these roles?

□ How has management used technology to implement strategic objectives?

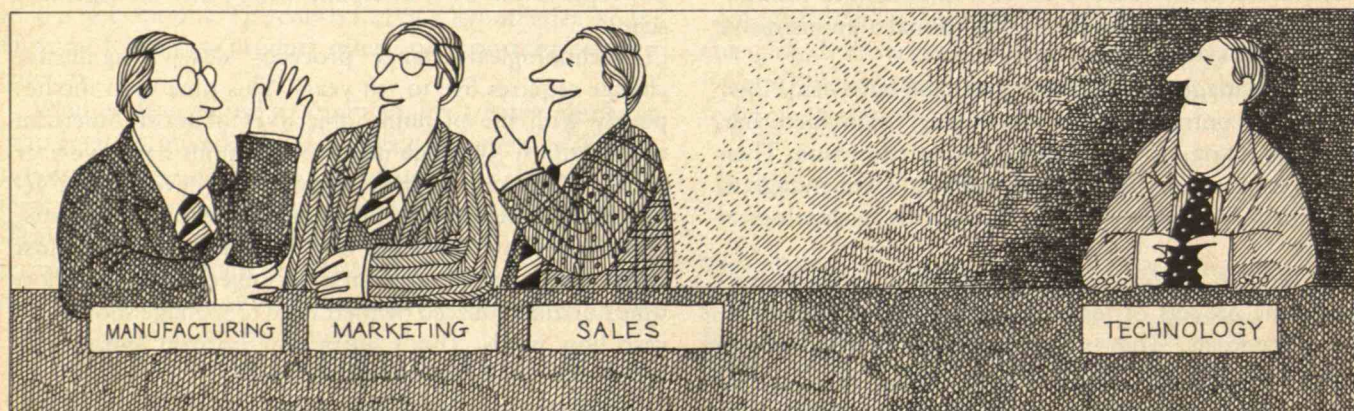
□ How has technology been monitored? (One of the simplest and most conventional ways is by simply maintaining a research and development department to keep abreast of the state of the art. Other methods include outside technology boards and liaison activities to keep informed on areas where your own technical resources are limited.)

□ How are activities relevant to technology recognized and organized in your enterprise? Where are they located, and how are they rewarded? (The typical corporate reward system is biased to short-term, cash flow performance; these criteria are simply not appropriate to the risks that must be taken in a viable technological development system.)

The Fundamental Units of Technology

To improve your understanding of technology in your corporation, you will need first of all an adequate unit of analysis.

When we talk about technologies, we tend to speak of specific techniques and products — internal combustion engines, refrigeration and air conditioning, and machine tools, for examples. But technology flows in and out of such products as these, and they do not provide the fundamental basis by which to measure technological change. The analysis must be on the level of generic technologies. A carburetor, for example, is an application of the generic technology of vaporizing a liquid and mixing it with a gas. The same technology applied in the paint industry might become an automatic paint sprayer or in the aerospace industry a jet backpack. This way of focusing on generic technologies and the variety of technical applications of each is necessary if your planning is to be effective at capturing the implications of technological



change that's going to affect a company's general product area. Consider, for examples, how Raychem and Hewlett-Packard have succeeded by concentrating on a single generic technology, developing and exploiting it in countless products for many different industries.

Seven Dimensions of Product Acceptability

Having defined the unit of technology for analysis, you now need some basic parameters for explicit analysis of how a given technology is to be applied in your company's products and how effective they will be as a result.

After collecting information from many corporations on the characteristics of successful new products, I have found seven qualities which determine the success of any embodiment of any generic technology by any industry:

- *Functional performance* — an evaluation of the basic function that a device is supposed to perform. For example, the functional performance of a household refrigerator is to remove heat, and engineers evaluate a refrigerator's performance of this basic task in terms of what is called "pull-down" efficiency.

- *Acquisition cost* — in the example of the refrigerator, the price per cubic foot.

- *Ease-of-use characteristics* — the form of the user's interface with the device; in the example of the refrigerator, magnetic door latches and automatic defrosters contribute to the consumer's acceptance of the technology.

- *Operating cost* — in the case of the refrigerator, the number of kilowatt hours used per unit of service performed.

- *Reliability* — the question of how often the device or process normally requires service, how free it is from abnormal service requirements, and — ultimately — what its expected useful lifetime is.

- *Serviceability* — the question of how long it takes and how expensive it is to restore a failed device to service.

- *Compatibility* — the way the device or product fits with other devices in the context of the larger system.

These are useful categories for analyzing applications of technologies because they are general, applying to everything from refrigerators to jet engines to medical services; they describe technology in a specific application very quickly and very adequately; they describe the goals of most research and development efforts; and they describe most of the emphasis in advertising and marketing strategies. Without such a set of dimensions, you will find yourself talking about the costs and benefits of potential technological change in haphazard, incomplete ways.

Technology Demand Elasticities

Economists talk about price elasticity for a product, an indication of the role of price in determining demand. In the same way, each of the different dimensions in which technological change can affect the acceptability of a product is subject to evaluation in a fashion analogous to price elasticity. For example, you can analyze the change in demand for a product when its functional performance has been improved, when its ease of use has been increased or its service requirements lowered. In some cases elasticity will be low, in other cases high. Such data can be

Charting a Federal Commitment to Innovation

How the U.S. should move to encourage innovation in technology-based industry is an important question on the 1978 agenda of the Office of Science and Technology Policy, and answers are a major goal of the Department of Commerce.

Frank Press, Science and Technology Adviser to the President, explained his concern in a major address to the 1978 annual meeting of the American Association for the Advancement of Science: many intermediate and even high technologies have been successfully adopted by developing countries, with a result that those countries' productivity has markedly increased. Meanwhile, the rate of innovation and of productivity growth in the industrial nations has slipped; and unless that trend can be reversed those nations will resort to protectionism instead of innovation as a means of preserving jobs and income. The eventual result would be the collapse of world trade and "global economic chaos," said Dr. Press.

"The harsh truth is that we are now very much locked into a dynamic system of global economic growth, and it is one based largely on technological change and innovation. . . . There are enormous pressures ahead for us to innovate and improve productivity," he said.

Much of Dr. Press' challenge falls on Jordan J. Baruch, Assistant Secretary of Commerce for Science and Technology, who finds himself on a knife-edged dilemma. "There are a huge number of 'knobs' we can twist to influence the rate and direction of innovation," he said at a Congressional hearing staged before the A.A.A.S. in February. "But every facilitating twist of a knob has a cost." Tax incentives to industry reduce tax income for social welfare; strengthening of the patent system risks strengthening of monopolies; subsidize industrial research and corporate funds, normally used for research, may suddenly become profits.

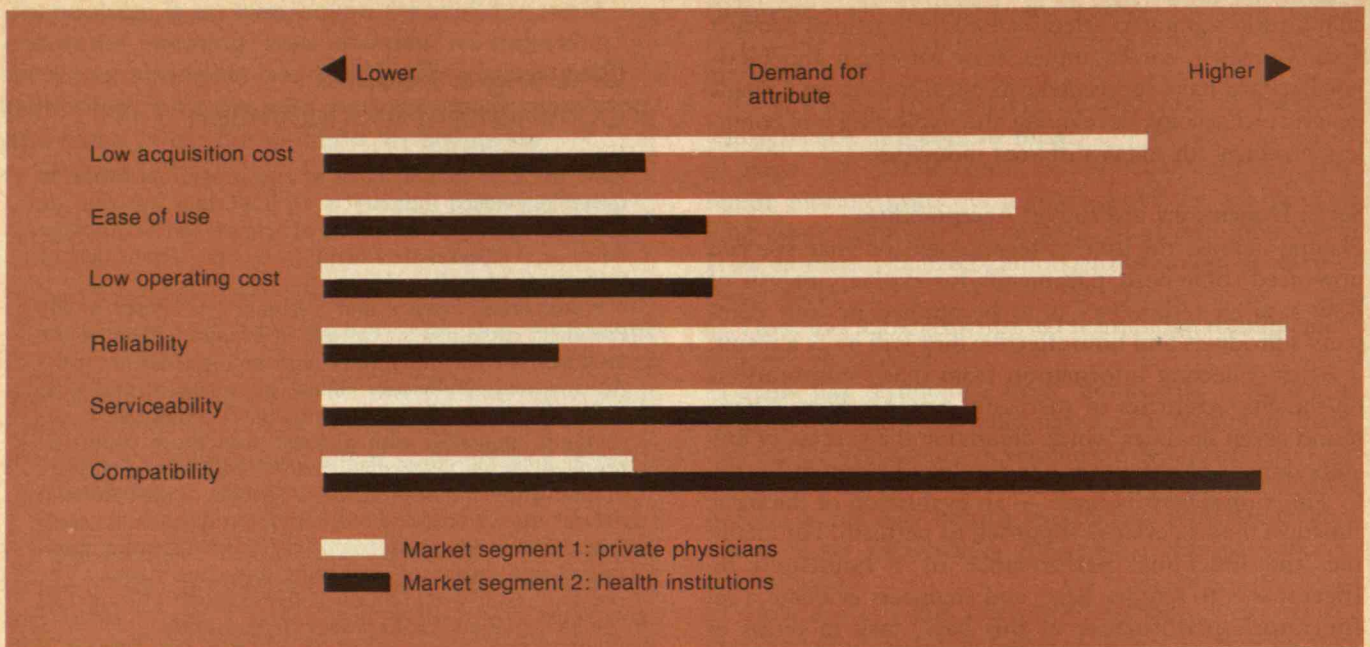
In other words, asked Dr. Baruch, "How do we manage an integrated federal policy that . . . provides effective incentives for industrial innovation while minimizing the short- and long-range social costs of that policy?"

Already one plan appeals to Dr. Baruch: institutionalize a partnership between government and an industry in developing "infratechnologies" which that industry needs. "Infratechnologies" are the fundamental building blocks, and after they've been developed by the industry-government partnership their application would be the responsibility of industry.

Economists give Drs. Press and Baruch little comfort in their effort. Many simply shrug their shoulders, saying that shifts of industries and labor are a natural consequence of economic change; it is in the world interest that its goods be made by the manufacturer and in the nation where costs are lowest and efficiency highest.

Dr. Baruch calls this a "zero-sum game — the idea that gains or winnings in one industry, one community, one nation are and must be accompanied by equivalent losses in another." And he rejects it: "Few of these macroeconomists have ever . . . watched the human impact of a plant closing or . . . seen the owner of a small firm watch his enterprise built by a lifetime of effort shrivel under the impact of intense foreign competition backed by the resources of an entire nation.

"We see the future role of technology," he told Congressmen at the A.A.A.S. hearing, "as one of converting the world to a 'non-zero-sum game.'" — J.M.



Matching the qualities which technology can impart to a product with the different needs of potential consumers. Cost is relatively unimportant to an institutional buyer of medical equipment — but it is a major consideration of the physician in private practice. Reliability is important to both; but the hospital may have a

technician to effect repairs promptly. An analysis such as this demonstrates the different technological market elasticities for the same product in different markets — an important concept in any firm's planning for future investment in technology.

measured and used in the same way as the economists obtain and use price elasticity.

Two types of elasticity — absolute and relative — are very important in technology planning. Absolute elasticity represents the responsiveness of total market demand to improvements in function, ease of use, reliability, cost, etc. Relative elasticity is a similar measure of the tendency for shifts in market share to occur as competitors introduce new products with better performance in one or more of the various dimensions.

To see how these ideas enter into technological planning, consider a piece of medical equipment. In one case the product is destined for emergency-room use in a hospital; in another the same functions are to be performed in an individual doctor's office. Some characteristics will be more important in one market than in the other. Cost and ease of use will be relatively unimportant to the hospital; medical insurance will pay most of the bills, and the machine in the emergency room will be operated by a technician. The individual doctor, who must collect from individual patients and use the machine without a technician's help, will put a higher priority on low cost and ease of operation.

Or consider the example of Black and Decker, a company that once concentrated exclusively on commercial and industrial construction tools. The technological demands and price constraints of that market are different from those of the market for home use; and until Black and Decker recognized the differences and developed its technology accordingly, its penetration of the home tool market was very small.

In short, there are significant differences among customers' preference sets and hence different technological

market elasticities. Calculation of technology elasticity results from analyzing statistically different market segments according to priorities in purchase decisions which can be established for each individual class of buyer.

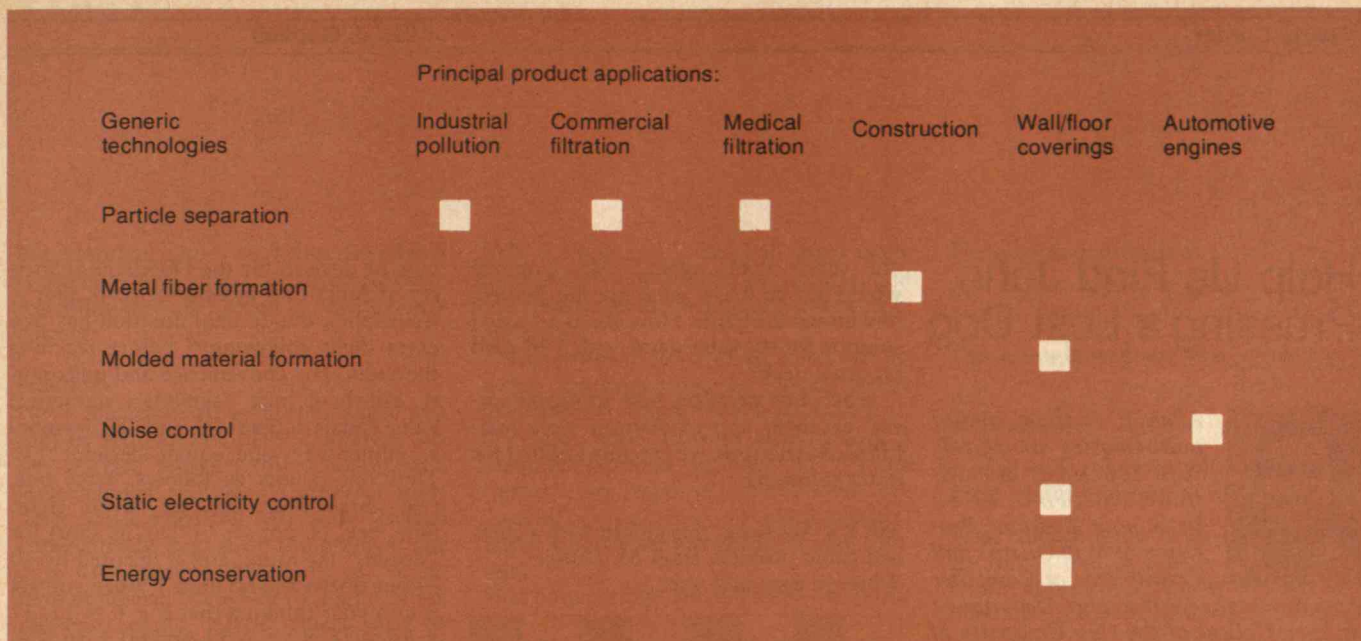
Profiling Technology by Market Segments

You now have determined a unit of technology on which to concentrate, the dimensions in which it is embodied in the market, and the relative demand for those dimensions. The next step is to apply these analyses to compare your company's technology with the needs by market segments, producing a competitive technological profile. Where do competitors' technologies stand in relation to yours in any particular market? Where did they stand a few years ago? And where are they going? Your goal, of course, will be to answer a question such as this: by the time my company's new technology-based product or service is in operation or on line, what will the competitive situation be?

The competitive profile helps answer that question by answering some simpler ones: what have the rates of change been in the past? And can one project a continuation of those rates into the future? How fast must one company move to gain ground on the others?

Assessing the Technology and Product Portfolio

To develop an overall technology strategy around your company's existing technical and business strength, draw a chart (such as that at the top of this page) to show the generic technologies in which your company is engaged and the products in which they are applied. Such a chart provides a profile of the portfolio of technologies and products which may be illuminating to a management



A profile of the generic technologies in relation to the principal products of a hypothetical company. All six of this company's technological interests are good examples of what the author calls generic technologies, all sensible responsibilities of a central research and development laboratory. But only one of them is germane to more than one of the company's products; three of

them result from the company's interest in the wall/floor coverings industry. Such a chart could be revealing to a management whose business has grown and developed in an opportunistic way. In this case it reveals that this company is actually two companies — one driving the technology of particle separation and one driven by the several technologies involved in floor coverings of several kinds.

whose business has grown and developed in an opportunistic way. A similar chart for competitors in your company's product lines will help reveal what competitors are doing and what has been their strategy.

The company whose chart we show at the top of the page may have difficulties in the future because it is trying to manage under the same roof different kinds of technology in which the manufacturer has different roles.

The chart reveals that particle separation is a primary driving force of this company's corporate strategy, and there is at least the possibility that the company intends to be a leader in that field. The chart also shows that another part of this company is pursuing strategy that emphasizes a product area, picking up all kinds of technologies because of their common applications. This company may be said to have two parts — one technologically driven and one driving technology. Their technological strengths, their laboratories, their organizations, their pursuit of joint ventures and acquisitions programs, and their technology strategy in general are different. Indeed, these two parts of the company are so different that the company as a whole may be weakened by having to accommodate two such very different enterprises in its management structure.

A chart of this kind is the first stage in combining all the ideas previously discussed so that you may understand the role of technology in your company and weigh the investment and strategy options that are open to it. To select a particular strategy, begin by considering the generic technological strengths of your enterprise. You may find that you have no adequate strengths; you may find that your strengths in technology are not complemented by strengths in manufacturing or marketing,

for example. Or you may find that your organization is fully prepared to drive a particular technology into many different product applications; or you may see that your best strategy is to capitalize on similar applications of different technologies. Depending on your analysis, you may want to add by merger a new generic technology in order to extend your applications area one step further; or you may want to offer your technology through merger to some firm which is equipped to capitalize on it through manufacturing and marketing.

In making these decisions, review the profile of your technologies by your market segments. Which technological dimensions of your products are important? Reliability? Function? Ease of use? Operating cost? How much emphasis will you place on reducing acquisition costs? On increasing ease of use? On reducing operating costs? On improving service?

This evaluation of technology dimensions in relation to market needs and competitive thrusts — the elasticity of technology demand — is the part that's missing from most research and development plans. But it provides answers to the crucial questions: what is your basic competitive advantage relative to other people? Why is your product or service going to sell? Why is it going to work in the marketplace?

Answering such questions succinctly and consistently will help many managements increase the strategic use of technology in their corporate planning.

Alan R. Fusfeld, in the Sloan School of Management's doctoral program at M.I.T., is Director of the Technology Management Group at Pugh-Roberts Associates, Cambridge, Mass. This article is adapted from his presentation to a symposium on "The Management of Innovation" sponsored by the M.I.T. Alumni Center of New York in December, 1976.

Help Us Find John Prussing's Lost Dog



Allan J. Gottlieb studied mathematics at M.I.T. (S.B. 1967) and Brandeis (A.M. 1968, Ph.D. 1973); he is now Assistant Professor of Mathematics and Coordinator of Computer

Activities in the Mathematics Department at York College of the City University of New York. Send problems, solutions, and comments to him at the Department of Mathematics, York College, Jamaica, N.Y., 11451.

A lament from the "Big Apple": New York in February was 12° F. colder than normal and three times as snowy. As a result our streets have not been swept in over 50 days; the previous record for days without sweeping for an entire winter is in the low 30s, and we may well double that mark.

My backlog of regular problems is in excess of two years and still growing. I thank you for the support. On the other hand chess problems are critically short. Unless new ones appear, we will soon be forced to revert to the previous practice of one bridge problem each month.

Finally, let me report that NS 8 was prematurely put to rest last December and has been revived. See "Better Late Than Never," in the June/July issue.

Problems

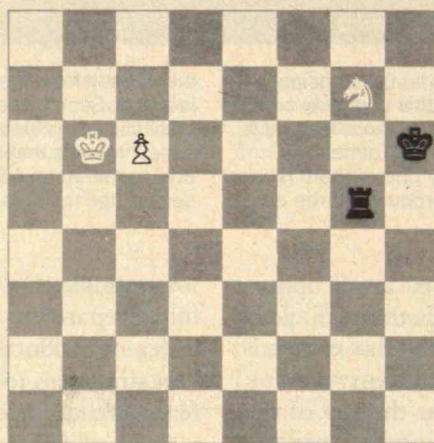
NS 12 This month we again present an old problem that was never solved (completely). Formerly 1974 J/A 4, this problem came from John G. Connine, who describes "a lesser known game of solitaire played in the snow-belt during long winter nights." (It is also played here in the pollution belt.)

A standard deck of 52 cards is shuffled and placed face down upon the table. The cards are then turned face up one at a time by flipping over the top card of the face-down stack. As this is done, the player simultaneously calls out the sequence A, 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A, 2, etc., one call being made for each card flipped over. To win the game, one must go through the deck without matching a card flipped over with the card called. Suits don't matter, so, for example, any 4-spot flipped over on the 4th, 17th, 30th, or 43rd turn results in a loss. "Since winter

will surely come again," Mr. Connine would like to know what are the chances of winning the game. How about a second solution for the same game with a 48-card pinochle deck?

When this problem first appeared several excellent approximations were published. So this time we are only looking for exact solutions.

MAY 1 We begin this month with a chess end-game problem from M. Laufer: White to play and win:



MAY 2 We next present a word problem from Donald Forman:

"Dentification" and "identification" are both English words. For each English letter α , what is the longest string β such that both β and $\alpha\beta$ (the concatenation of α followed by β) are English words? Pairs such as "allelujah" and "hallelujah" or "enanthaldehyde" and "oenanthaldehyde" are excluded, since they are simply variant spellings or variant pronunciations of the same word.

MAY 3 Sheldon Razin offers us a checkerboard problem:

Given an n -by- n checkerboard and n^2 checkers of n different colors, and given that there are n checkers of each color, is it possible to arrange all the n^2 checkers on the board such that no two checkers of the same color lie in the same row, column, or diagonal? (By "diagonal" is meant *all* the diagonals, not just the two main diagonals.) It turns out that for certain values of n it is possible to so arrange the checkers; in this case we say a solution exists — e.g., $n = 1$. But for certain other values of n such an arrangement is impossible — i.e., no solution exists. For which values of n does a solution exist?

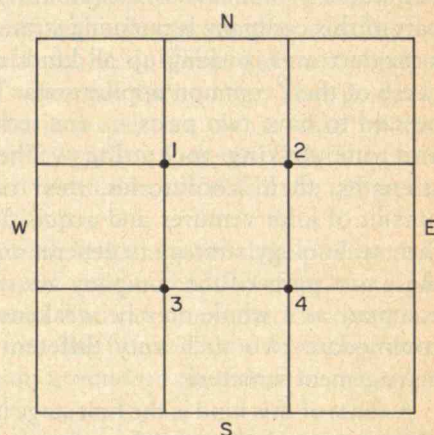
MAY 4 A base-12 cryptarithmic problem from William Schumacher, which he

says he devised for the Duodecimal Society of America a number of years ago: Remember, duodecimal notation has two extra digits following 9 before reaching the radix. For convenience and uniformity, call these "dek" (symbol x , numerical value equals decimal 10) and "el" (symbol ϵ , numerical value equals decimal 11). Thus one counts as follows: zero, one, two, three, four, five, six, seven, eight, nine, dek, el, do, ... ("Do" is short for "dozen," the radix, and is denoted by 10 — one dozen and no units.) When you get it into your thinking that $8 + 6 = 12$, $17 + 14 = 2\epsilon$, $9 \cdot 5 = 39$, and $60 \div 16 = 4$, the rest comes easy. The problem is to assign numerical values to each letter:

HEN
AARON) PHARAOH
AARON
OOYPO
BBNYZ
AEYDNH
ACEPHH
ERPZC

MAY 5 John Prussing needs your help to find his lost dog:

A dog is lost in a square maze of corridors. At each intersection, he chooses a direction at random and proceeds to the next intersection or exits at one of the sides. His walk is over when he reaches one of the sides. What is the probability P_k that the dog, starting at intersection k , will exit at the south side?



Speed Dept.

MAY SD 1 R. Robinson Rowe has sent us a "metric sequel or alternative": A fence around a circular corral is as long in meters as there are ares contained. What is the radius of the corral?

MAY SD 2 A Jimmy-the-Greek-theoretic game from William Blake:

Nine football games are being played this weekend; how many predictions (win, lose — no ties) are needed to be *sure one* is correct?

Solutions

NS 9 In each of 16 squares arranged in a four-by-four square, place a *different* letter, selected so each row, column, and long diagonal will spell a *different* four-letter word when the letters are selected consecutively in one or the other of the only two possible directions, as we do with numbers. There will be a total of ten different words, all of which must be defined in any one edition of Webster's dictionaries.

Several readers found this too easy this time and arranged for the letters to be selected in the forward direction. Avi Ornstein sent us the following:

C R A M
L O R E
E A S E
F R E T

Also solved by Mark Green, George Ropes, Raymond Kinsley, Marshall Bern, and Winthrop Leeds.

JAN 1 What is the largest contract that can be made from three positions on the same deal? From four positions? Assume best defense.

No takers so far.

JAN 2 Find, for each n and each j , integers X_1, X_2, \dots, X_j, W , and Z such that $X_1^n + X_2^n + \dots + X_j^n = W^{n-1} = Z^{n+1}$.

The following is from Harry Zaremba: With $W^{n-1} = Z^{n+1}$, we can assume that W and Z are each multiples of some integer A . If we let $W = A^{n+1}$ and $Z = A^{n-1}$, then $W^{n-1} = Z^{n+1} = (A^{n+1})^{n-1} = (A^{n-1})^{n+1} = A^{n^2-1}$.

The problem as stated does not impose the constraint that each integer X_i must be distinct. Consequently, if we assume each X_i equals A ,

$$\sum_{i=1}^j X_i^n = jA^n = A^{n^2-1}, \text{ or } j = A^{n^2-n-1}.$$

Hence, the equation has a solution for any $n = 2, 3, 4, \dots$ and any integer A when $W = A^{n+1}$, $Z = A^{n-1}$, and $X_i = A$ for $j = A^{n^2-n-1}$ number of identical integers. The solution appears trivial but satisfies the problem as given.

Also solved by Frank Rubin, Alan LaVergne, and the proposers, J. Kleilin and Bob Martin.

JAN 3 How can a baseball team make three triples, one double, two singles, and steal two bases in one inning without scoring a run?

This problem has created some real interest. Someone from the Detroit Tigers telephoned to inquire about it. (Last year, the New York Yankees asked about a previous baseball problem in "Puzzle Corner"; my response inspired them to a "world" — i.e., U.S. — championship.) James Cooney sent us the following solution:

First batter triples and is picked off — one out.

Second batter triples and is picked off — two outs.

Third batter doubles.

Fourth batter singles but no advance by the third batter.

Double steal to 3rd and 2nd base.

Fifth batter singles — no advance — bases loaded.

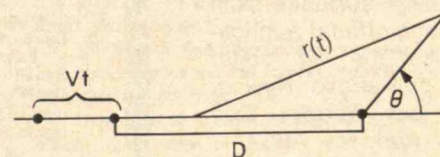
Sixth batter homers, but runner coming in from third fails to touch home plate and hence is called out — third out.

Sixth batter is credited with a triple.

Also solved by Harry Zaremba, Frank Rubin, Bleiweiss, Robert Sutton, Kenneth Glass, Mark Astolfi, Hal Moeller, Jack O'Neill, John Corrigan, Dick Segers, John Rudy, and Alan LaVergne.

JAN 4 Suppose you suddenly realize that you are (on foot) directly in the path of a midwestern tornado which is approaching with a speed of V_T . The tornado has a lethal radius of R_L . You wish to take a path which maximizes your chance of survival. Your speed is $a - bt$ (in which a and b are positive constants). In which direction should you head, and will you escape?

The following is from Alan LaVergne:



Let $F(t)$ be the distance you have traveled by time t , so that your speed is $F(t)/t$. Let V be the speed of the storm, and D its distance from you at time $t = 0$. You will take a straight-line course at an angle θ with the line between you and the center of the storm. You will choose θ so that the minimum (over time) distance between you and the center of the storm is maximized.

Let $r(t)$ be the distance between you and the center of the storm.

Then, by the cosine law,

$$r(t)^2 = (D - Vt)^2 + F(t)^2 + 2(D - Vt)F(t) \cos \theta \quad (1)$$

This is minimized at $t = \tau$, where

$$\left. \frac{dr^2}{dt} \right|_{t=\tau} = 0, \text{ i.e., } -V(D - V_\tau) - F(\tau)F'(\tau) + (D - V_\tau)F'(\tau) \cos \theta - VF(\tau) \cos \theta = 0 \quad (2)$$

This τ depends on θ , so let $\rho(\theta) = r(\tau)$ for this τ ; that is, $\rho(\theta)$ is the distance of closest approach for the given angle θ . To maximize $\rho(\theta)$, we set $d\rho^2/d\theta = 0$, where

$$\rho^2(\theta) = (D - V_\tau)^2 + F(\tau)^2 + 2(D - V_\tau)F(\tau) \cos \theta.$$

Since

$$\frac{d\rho^2}{d\theta} = \frac{\delta\rho^2}{\delta\theta} + \frac{\delta\rho^2}{\delta\tau} \frac{d\tau}{d\theta}$$

and $\delta\rho^2/\delta\tau = 0$ by (2), we must have $\delta\rho^2/\delta\theta = 0$. Therefore $(D - V_\tau)F(\tau) \sin \theta = 0$. $\theta = 0$ obviously represents a mini-



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mum whenever (as in this case) $V_t - D$ eventually exceeds $F(t)$. Hence the maximum is at $\tau = D/V$. Plugging this into (2), we find $\cos \theta = F'(\tau)/V$. In our particular case $F'(\tau) = a - b\tau = a - bD/V$, so $\cos \theta = a/V - bD/V^2$. You escape if $\rho(\theta) > R_L$, and since $\rho(\theta) = F(\tau)$, this translates to $R_L < a\tau - \frac{1}{2}b\tau^2 = a(D/V) - \frac{1}{2}b(D/V)^2$. Finally, in order for the solution to make any sense, we must have $F'(\tau) \geq 0$, or $aV \geq bD$.

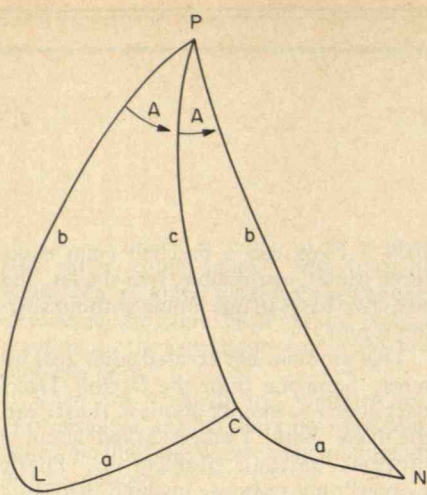
If $aV < bD$, the maximum is at the "endpoint" or $F(a/b)$ and $\theta = 90^\circ$, since $F'(t) = 0$ for $t \geq a/b$. The escape criterion is then $F(a/b) > R_L$ or $a^2 > 2bR_L$.

Also solved by Harry Zaremba, R. Robinson Rowe, and Winslow Hartford.

JAN 5 A satellite is orbiting earth and is now directly above Chicago. How far from the center of the earth is the satellite if New York City and Los Angeles bound the horizon? You are given the following information:

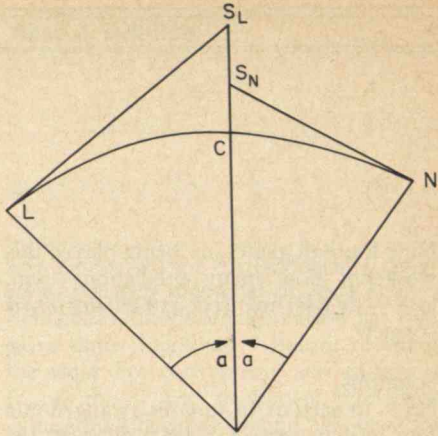
	Latitude	Longitude	Altitude
New York	40°45'06"N	73°59'39"W	55 feet
Chicago	41°52'28"N	87°38'22"W	595 feet
Los Angeles	34°03'15"N	118°14'28"W	340 feet

The diameter of earth is 7926.69 miles.
A complete analysis from R. Robinson Rowe:
The first diagram (above) shows two spherical triangles with P at the north pole



and N, C, and L at New York, Chicago, and Los Angeles. For each of them we have two sides b and c , the co-latitudes, and A , the angle at the pole, being the difference in longitudes. The figure with two sides and the included angle is solved for the third side by $\cos a = \cos b \cos c + \sin b \sin c \cos A$

For PCN: $A = 13.645 \ 277 \ 778$
 $b = 49.248 \ 333 \ 333$
 $c = 48.125 \ 555 \ 556$
 Whence $\cos a = 0.983 \ 886 \ 8920$
 $a = 10.299 \ 405 \ 84$



For PCL: $A = 30.601 \ 666 \ 667$
 $b = 55.945 \ 833 \ 333$
 $c = 48.125 \ 555 \ 556$
 Whence $\cos a = .904 \ 780 \ 2505$
 $a = 25.206 \ 297 \ 23$

The second diagram (above) shows a section (developed) thru N, C, L and the earth's center at O, with the angles a now at the center. Using the given earth's diameter and the elevations of N, C and L, the distances in miles are:

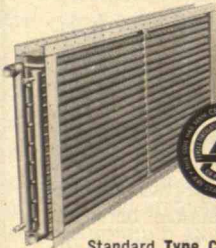
ON: 3963.355
 OC: 3963.458
 OL: 3963.409
 If N is on the horizon of the satellite, it is

COIL CLOUT

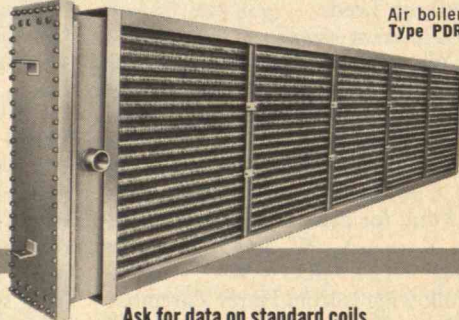
In a changing thermal world,
Aerofin's 55-year-old Heat Transfer
Technology earns new respect

Coils are our bread and butter. We engineer precisely, control quality and watch the economics because our reputation depends on it. We understand the interaction of heat transfer, fluid flow and related apparatus to deliver the exact right system temperature.
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at S_N and ONS_N is a right triangle with

$$OS_N = 3963.355/\cos a = 4028.262 \ 834$$

If L is on the horizon of the satellite, it is at S_L and OLS_L is a right triangle with

$$OS_L = 3963.409/\cos a = 4380.521 \ 124$$

Perhaps Elentuck can explain the apparent discrepancy of the satellite being at two different elevations about 350 miles apart. Or maybe he intended this as a gimmick in the problem for the solver to unravel. The true horizon as seen from an elevated point is a circle, the locus of tangents to the earth thru the elevated point. The center of the locus circle is on the line OS . N and L could not both be on the true horizon because their angles a were different. But these tangents "graze" the earth so that landmarks some distance from the true horizon seem to lie on it. Thus if L could be seen and the satellite was at S_L , N could also be seen — with nothing beyond it to the true horizon but the ocean with no landmarks. Also solved by Harry Zaremba and Winslow Hartford.

Better Late Than Never

1977 MAY 2 and J/A 2 Frank Rubin has responded.

O/N 1 Caruthers Coleman has responded.

O/N 2, O/N 3, and O/N 5 Frank Rubin has responded.

DEC 1 Frank Rubin, Harry Hazard, Elliot Feit and Gardner Perry have responded.

DEC 3 Gardner Perry, Elliot Feit, Frank Rubin, and Naomi Markovitz have responded.

DEC 4 Naomi Markovitz, Frank Rubin and Edward Lynch have responded.

DEC 5 Edward Lynch, Frank Rubin, Naomi Markovitz, Mary Lindenberg and P. Jung have responded.

Y 1977 Harry Hazard points out $22 = [(9 - 1) + 7] + 7$ and $50 = 1 \cdot 9 + 7 \cdot 7$.

1978 JAN SD 2 Ben Suetitsky feels that it is immaterial where the walker stops providing he walks at the same rate both on and off the elevator. If, in addition relativistic considerations are applied, the man should stop while on the elevator.

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Reconstructing the Evolution of Life

All of today's living things can be divided into two classes — the prokaryotes and the eukaryotes. Bacteria are prokaryotes; their cells are bundles of molecules with no subcellular compartments. But yeast and all higher animals, including man, are eukaryotes, their cell constituents subdivided into many groups contained in internal sacs.

How should it be that such a fundamental difference exists in the basic structure of living things? If all life arose from a primordial "soup" of biomolecules, drawing upon its contents for the building blocks of cells and using carbon dioxide and sunlight or hydrogen as the source of energy, was there once a single organism, a bridge between today's prokaryotes and eukaryotes?

Ever since the hypotheses of a primordial "soup" was made 50 years ago by A. I. Oparin in the Soviet Union and J.B.S. Haldane in Britain, scientists have searched for aberrant organisms with characteristics which fit into neither group. Such a "missing link" between the two groups which are now known might in fact shed light on the links between today's organisms and those which first emerged to inhabit the earth.

Methanogens now being studied by Carl Woese of the University of Illinois at Urbana are attracting attention because they seem to deviate considerably from the norm of most cellular behavior. These organisms use carbon dioxide and hydrogen to produce energy and methane — therefore their name; and Dr. Woese believes they differ in many respects from bacteria. In fact, he suggests that the methanogens may be "the most ancient divergence yet encountered in the bacterial line of descent." Perhaps these are the close relatives of the original organisms which evolutionists have been looking for.

Uttam L. RajBhandary of M.I.T. has been looking at the extreme halophiles, bacteria which must live at very high salt concentrations. Their unusual ecological niche suggested that they might have many strange characteristics. In fact, it now turns out that, though halophiles superficially resemble the prokaryotes, much of their biochemistry is similar to that of the eukaryotes; perhaps the "missing link"?

Information leading to such hypotheses usually comes from studies on three classes of molecules found in cells: proteins, DNA, and RNA. All of these molecules are long chains; proteins have

links called amino acids, while the links in DNA and RNA are called nucleic acids. Transfer RNA (tRNA), one subclass of RNA, is often used for these analyses because the chains are short and therefore easy to study.

Using enzymes, scientists clip apart the tRNA into fragments of workable size and then determine which nucleic acids are included in each fragment and in what order. The sequences of the fragments are then pieced together like a jigsaw puzzle to obtain a picture of the entire molecule and eventually of the cell. If the original molecule is too large and the puzzle too complex, then the fragments are analyzed separately. The molecules are compared to others which have been studied previously and the similarities help to fit the organisms into the plan of cellular evolution.

Though studies of this type may give clues about the evolutionary position of the organisms, no certain conclusions seem possible. Most scientists agree that, since we will never know exactly what the world was like 3 billion years ago, we will never be sure exactly how Earth's biological system began. — *Jan Hack, M.I.T.* '79 □

Old Buildings: New England's Energy Advantage?

Modern architectural and engineering systems are costly to build and operate. The use of simpler systems typical of older buildings could save America as much as 20 per cent of the energy we use every year, and capitalizing upon this strategy could signal the rescue of decaying Northeastern cities.

Over the past 50 years, American industrial architecture has given us massive glass and steel structures with sealed environments — where interior air is heated or cooled without the admixture of outside air. Data from M.I.T. buildings, provided by Carl Haggie, Environmental Engineer in the Physical Plant Department, show just how costly modern architecture can be in relation to M.I.T.'s older buildings.

The Green Building, one of the best examples of modern architecture on the M.I.T. campus, costs about 90 cents per square foot per year to heat and cool. At the other extreme, Bexley Hall, an old brick-and-mortar dormitory with operable windows for "air-conditioning," costs only 30 cents per square foot per year to heat. The Sloan Building, with a cost of 68

cents per square foot per year for temperature control, with central heating and air-conditioning, is an intermediate design — it's built of masonry, with modest-size moveable, double-hung windows.

The primary source of the increased energy cost of modern buildings is the concept of a sealed environment. Consider, for example, a building in the Northeast on a sunny day in May, June, or September. As the sun warms the building the temperature inside becomes uncomfortably high. In a modern, sealed building, the air conditioning goes on and in a short while the building is comfortable again. But in the older building the windows are thrown open and the building cools down — without so much as a dime being spent on refrigeration.

A secondary reason for the difference in heating costs may be found both in the nature of the building material and in the surface-to-volume ratio.

It is well known that steel conducts heat better than masonry or wood. Older buildings with thick masonry walls have a much higher thermal inertia than do steel and glass structures. On a hot day a masonry building will stay cool longer inside than will a steel building.

Finally, tall skyscrapers and one-story factories have one feature in common: a high ratio of exposed surface to volume. Since heat travels through exposed surfaces, a tall or flat building is obviously more expensive to heat or cool than a cube-shaped building of the same volume.

Added together, building materials, exposed surface-to-volume ratio, and method of controlling the environment account for a considerable difference in operating costs — three times more in the case of the Green Building vs. Bexley Hall.

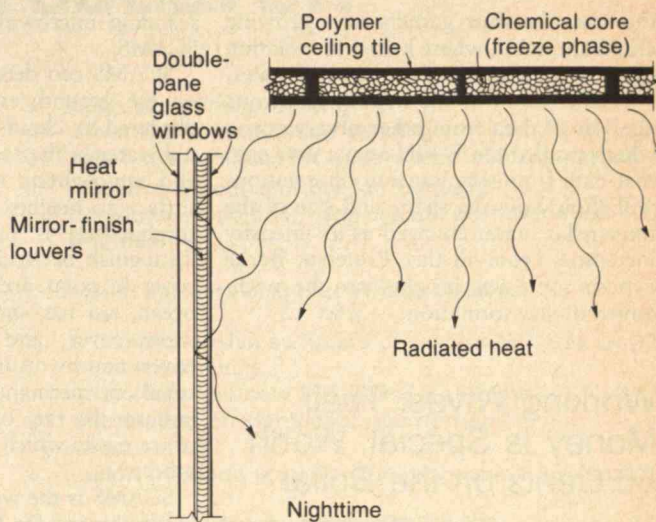
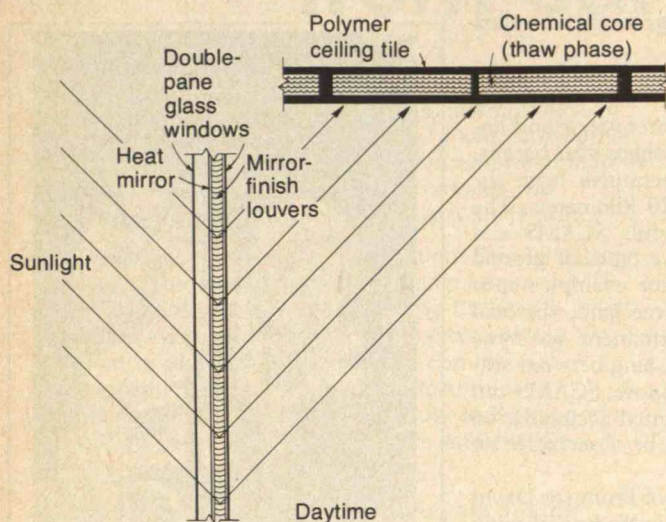
A return to older building forms, materials, and management could have enormous implications for the U.S. Over half of our national energy consumption is used to heat and cool our homes and workplaces, and two-thirds of that heats our factories, while only 21 per cent is used in manufacturing.

If half our industrial space is modern in design we are wasting as much as 13 per cent of our annual energy outlay. If we include housing we waste almost 20 per cent — as much as we use in manufacturing and almost as much as we use in transportation. As industry becomes more concerned about the cost of energy, we may find that the older industrial centers of the Northeast have a great resource in the form of older, inexpensive (both to purchase and to operate) industrial space. — *Stephen R. Glines, M.I.T.* '81 □

Two diagrams capture the principal features of the "passive" solar heating system now being tested in an M.I.T. classroom. Sunlight passing through double-glazed

windows is reflected to ceiling tiles, which contain heat-absorbing Glauber's salts and other chemicals. When solar energy is not available, heat is given up by the ceiling tiles

to the interior of the building as the salt solution solidifies. Special double-glazed windows provide night-time insulation.



Look — No Wires! A Stand-Alone "Passive" Solar House

Almost every solar-heated building — especially in New England — is designed to rely on an umbilical cord, a line which brings in electricity to power pumps and fans. A new solar building just finished and opened at M.I.T. is an exception: it's a "passive" solar-heated classroom that collects, stores, and radiates heat from the sun using only its own building materials.

The most important components of the system are polymer concrete ceiling tiles, two feet square and one inch thick, filled with a mixture of Glauber's salts (sodium sulphate and water), extremely pure "fumed" silica, and other chemicals. At just over 70° F this "filling" changes phase from liquid to solid, liberating large quantities of heat — just as water does when it changes to ice.

During daylight hours the ceiling tiles absorb solar thermal energy, changing from solid to liquid; their heat capacity is so great that overheating of the room even in bright sun is minimal. At night, the panels give off heat, and their contents change back from liquid to solid.

The little classroom building — it's 900 square feet in area — has eight large south-facing windows made of two panes of glass sandwiching a coated, transparent plastic sheet. Heat loss is only 25 per cent that of conventional double-pane glass, while transparency is reduced only 20 per cent. The secret is the plastic — a proprietary product of Suntek Research Associates of Corte Madera, Calif., called Heat Mirror®.

Reflective blinds inside the window direct sunlight upward onto the ceiling tiles; they're closed at night to further reduce heat losses through the windows. Seasonal changes in the sun's altitude will require users of the building to adjust the blinds about once a month to reflect sunlight onto the ceiling with greatest efficiency.

Except for the blinds, the system has "no moving parts whatsoever," says Timothy E. Johnson, Research Associate in the Department of Architecture who heads the "passive" project. That contrasts with conventional solar heating systems, which require plumbing, pumps, blowers, and other powered equipment. Mr. Johnson's principal collaborator, Sean Wellesley-Miller, Assistant Professor of Environmental Controls, calls it a "total natural approach" to solar heating — a major advance. "Earlier experiments have been marked by overheating, inefficiency, and glare," he says.

The building materials for a "passive" system are slightly more expensive than those for building a conventional "active" solar house; but the latter includes pumps, fans, and controls, and owners must plan on the operating costs of these devices over the lifetime of the house. Mr. Johnson says that conventional, mechanized solar heating systems pay for themselves in New England in 30 years, compared with oil heat at present prices; a "passive" system should return its owner's investment in but ten years.

The ceiling tiles for the "passive" house are designed according to research performed at M.I.T. with the assistance of Architectural Research Corp. of Livonia, Mich.; they're marketed under the trade name Sol-Ar-Tile®. The chemical they contain, also developed at M.I.T., was

produced for the demonstration building by Cab-O-Sil® Division of the Cabot Corp. In addition to these industry participants, the "passive" house project has been funded by the Department of Energy and M.I.T.'s Godfrey L. Cabot Research in Solar Energy Fund. — J.M. □

Maser Radiation

It was quiet at M.I.T.'s Haystack Radio Observatory on the warm spring Sunday afternoon of May 8, 1977 — just a year ago — when Aubrey Haschick, a graduate student in physics, was looking at the area of space known as W30H, some 6,000 light-years from Earth. It's an area in which many stars are believed forming, and Mr. Haschick's search was rewarded: a new source of maser radiation from water molecules.

Within several days it was obvious that this new radiation source was growing brighter at the rate of about 10 per cent a day; and by May 12 Professor Bernard F. Burke of M.I.T. decided to ask other observatories worldwide to look at W30H.

During the next three weeks, astronomers for the first time made careful observations of what is called an "interstellar maser" as this mysterious radiation source first stabilized and then gradually weakened and disappeared.

Professor Burke hypothesizes that the maser radiation is generated by water molecules in a gathering cloud of interstellar dust — the first phase of the process of star formation. When such a mass of dust weighs perhaps ten times as much as the sun, a nuclear reaction begins and the star becomes luminous. The flow of dust is halted by radiation; instead of falling into

the star, the dust gathers in a growing cloud around it, where heat and radiation cause maser action in the water molecules.

Confirmation of the hypothesis awaits analysis of data from other observatories which studied the W30H area a year ago; that data from simultaneous observations will show how the shape and size of the interstellar maser changed as its intensity increased. From all this, Professor Burke expects some new insights into the mechanism of star formation. — J.M. □

Working Wives: Their Money Is Special, Worth 50 Cents on the Dollar

The money a working wife brings into a household is different from that which her husband earns — it has less clout. In almost every case, the man's income "is the rock on which the family depends"; it sets the style in which they live, says Richard P. Coleman, Senior Research Associate in the Joint Center for Urban Studies of M.I.T. and Harvard.

If the husband earns \$15,000 a year and the family lives in a \$30,000 home, writes Dr. Coleman in a report which is part of a study on the relationship of income levels and life-styles in America, you might expect that when the wife goes to work at \$10,000 a year the family would move into a \$50,000 home. But it doesn't happen that way; a wife's earnings are rarely used to elevate a family into a higher social class.

Why, then, do wives work? They want what Dr. Coleman calls a "hidden bonus": some additional decision-making authority in the household; they want to get out of the house, adding to their experiences and interests; or they want some extra comforts within the scale of their family's life-style — nicer clothes, better vacation, bigger boat, or safer retirement.

Considered in terms of its impact on her family's life-style, a working wife gets only about 50 cents for every dollar she earns, says Dr. Coleman. — J. M. □

Seeing Earth Through the Clouds

Infrared monitors aboard satellites are now routinely used to observe heat releases from earth to space. Now a new band of such releases — in the region of microwave instead of infrared radiation — can be measured by a satellite-mounted

scanning microwave spectrometer called SCAMS.

SCAMS can detect snow and ice cover on the ground, even though it may be obscured by clouds; water vapor and liquid water in the atmosphere over oceans; and atmospheric temperatures from the surface to heights of 20 kilometers. The combination is powerful: SCAMS can distinguish between five types of ground cover in polar areas, for example: open ocean, sea ice, snow-free land, seasonal snow cover, and permanent ice-snow cover; and by distinguishing between seasonal and permanent snow, SCAMS can indicate the rate of annual accumulation of ice packs which can be observed in no other way.

SCAMS is the work of Professor David H. Staelin and Dr. Phillip W. Rosenkrantz of M.I.T.'s Research Laboratory of Electronics; it was built under the direction of Frank T. Barath of the Jet Propulsion Laboratory. An improved version will be aboard the Tiros-N satellites scheduled for launch next summer. — J. M. □

Energy Conservation Videotapes

Five videotapes produced by M.I.T. and Educational Communications/Systems, Inc., of Boston for workshops on energy conservation in buildings are now available for general distribution from the Department of Urban Studies and Planning. The series includes how to make a walk-through energy audit of a building, principles of combustion in oil-fired boilers, operations of typical heating and ventilating systems, methods of reducing building heat losses, and how to save energy in illumination. For information, write to Professor Thomas E. Nutt-Powell, Room 9-641, M.I.T. □

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Short courses in more than 50 subjects of current interest in science, engineering, management, and planning will be given by members of the faculty during the coming summer at M.I.T. Titles range from nuclear reactor safety and fermentation technology to research and development management and technical writing and editing; the courses are scheduled as full-time activities for one, two, or three weeks between June 12 and September 1. For subjects and dates, write to the Office of the Summer Session, Room E19-356, M.I.T., Cambridge, Mass., 02139. □



Imperfections in the Hip Joint

The human hip joint has remarkable mechanical qualities: it's normally lubricated for life, it sustains forces and pressures — even during normal activity — which are three to five times body weight, and its operation is almost completely frictionless.

In learning these facts, Robert W. Mann, Whitaker Professor of Biomedical Engineering, and his colleagues at M.I.T. and in Boston-area hospitals have always assumed that the pressure exerted by thigh bone against hip socket was uniform, axisymmetrical. New measurements now indicate that the pressures are distributed irregularly, even in hip joints which seem absolutely normal; and Dr. W. H. Harris, Chief of the Hip and Implant Unit at Massachusetts General Hospital (who is collaborating in the research), thinks these minor abnormalities may be "the first indication of the development of arthritis in the joint," Dr. Mann says.

Research is continuing to confirm this hypothesis, the goal being to obtain by use of a prosthesis the first measurements of pressures within a living human hip.

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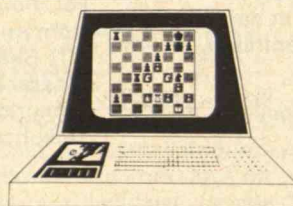
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Salisbury

Continued from p. 9

guard action too long, Dr. Rowsell argues: "Instead of fearing a take-over from outside, the scientific community should join with the reasonable animal welfare people and take the lead."

The schism within the scientific community became public last October when the Federation of American Scientists (F.A.S.) issued a statement on animal rights. In its newsletter, F.A.S. Director Jeremy Stone noted that there are legitimate moral questions to be answered and blamed animal experimenters for over-reacting "not only to any constructive proposals for change but even to minor turns of phrase in little-read government documents."

Though positions within the scientific community differ widely, public attitudes reveal sharp inconsistencies.

In general the public seems to favor — perhaps unwittingly — animal experimentation. Environmentalists and consumerists have backed legislation which drastically increases the number of animals being used to test the safety of various products, substances, and chemicals.

Every so often, however, a specific incident evokes widespread opposition.

In 1973 Congressman Les Aspin learned that the Air Force and Army were buying several hundred beagles for tests with poisonous gases. Antivivisectionists took up the cause and ran large advertisements decrying these experiments in a number of major newspapers.

The result was a deluge of mail which the Department of Defense ruefully acknowledged to have surpassed the amount which they received regarding the bombings of North Vietnam and Cambodia.

Despite the strength of this singular response, it did not halt or produce a review of research which involved 200,000 other dogs, let alone experiments involving cats, birds, or monkeys. This example demonstrates another inconsistency in the public attitude which is denounced by Mr. Singer. The public is much more dismayed by research using pet animals than it is by research on rats, salamanders, monkeys, or other less familiar animals.

The doctrine of animal rights is a natural marriage of evolutionary theory and Western morality. Like evolution itself, the resistance to animal rights is due to the challenge it presents to entrenched attitudes we are not ready to abandon.

Yet as Steven Jay Gould suggests in *Ever Since Darwin*, "The true Darwinian spirit might salvage our depleted world by denying a favorite theme of Western arrogance — that we are meant to have control and dominion over the earth and its life because we are the loftiest product of a preordained process."

Such a spirit demands an entirely new attitude towards other animals. Let us hope it is not too long in coming. □

"I'll have to take these for the rest of my life. Thank God."

by Sy Levin.

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